U.S. DEPARTMENT OF COMMERCE
National Technical Information Service

PB-291 178

A National Environmental/Energy Workforce Assessment. Post-Secondary Education Profile Composite I (Environmental Engineering/Health)

National Field Research Center, Inc., Iowa City, IA

Prepared for

Environmental Protection Agency, Washington, DC

Dec 78

TECHNICAL REPORT DATA

(Please read Instructions on the reverse before completing)

1. REPORT NO.

2.

3. RECIPIENT'S ACCESSION NO. PB291178

4. TITLE AND SUBTITLE
PHASE II OF A NATIONAL ENVIRONMENTAL/ENERGY WORKFORCE ASSESSMENT — POST SECONDARY EDUCATION PROFILE: COMPOSITE I (ENVIRONMENTAL ENGINEERING/HEALTH)

5. REPORT DATE December 1978 — date of completion

6. PERFORMING ORGANIZATION CODE

7. AUTHOR(S)
National Field Research Center, Inc.

8. PERFORMING ORGANIZATION REPORT NO.

9. PERFORMING ORGANIZATION NAME AND ADDRESS
National Field Research Center, Inc.
P.O. Box 287
Iowa City, Iowa 52240

10. PROGRAM ELEMENT NO.
2BC651 (36)

11. CONTRACT/GRANT NO.
Grant # T900591-02

12. SPONSORING AGENCY NAME AND ADDRESS
U.S. Environmental Protection Agency
401 M Street, S.W.
Washington, D.C. 20460

13. TYPE OF REPORT AND PERIOD COVERED
Phase II Final Report

14. SPONSORING AGENCY CODE

15. SUPPLEMENTARY NOTES
with emphasis

16. ABSTRACT

This study is one of 16 volumes aggregating data on representative environmental education offerings in the United States at post-secondary education institutions and in the private sector of the economy. Structured around on-site interviews, the study describes the institutions' education programs — their program structure, representative course offerings, faculty structure, and program requirements. In addition, the study provides information on the employment history of graduates.

Designed as Phase II of a three-phase program, the study presents the information on schools in the following volumes: two volumes on potable water and two on wastewater; one volume each on air, noise, pesticides, radiation, solid waste and energy; a two-volume composite report on environmental engineering/health; a one-volume report on education/ecology; and a volume on some training programs conducted by businesses and by trade and professional associations. In addition, the study includes a one-volume abstract and a one-volume summary. The study is an overview. It doesn't include all environmental programs in the United States, and it makes no attempt to evaluate the program offerings.

Phase I of the study assessed the workforce needs (manpower needs) for pollution control and abatement in the United States for the five-year period of 1976 through 1981. Phase III, which will be available in September 1979, will offer recommendations, curriculum changes, and modifications that appear necessary to assure a properly trained national environmental workforce

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS		b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
Air Pollution Water Pollution Solid Wastes Potable Water Pesticides Radiation Noise Pollution Energy Manpower	Environmental Engineering Environmental Health Environmental Education Environmental Protection Pollution Control Instruction Schools Education Ecology	National Environmental/Energy Workforce Assessment	

18. DISTRIBUTION STATEMENT
Release unlimited

19. SECURITY CLASS (This Report)

20. SECURITY CLASS (This page)

21. NO. OF PAGES 278

22. PRICE PC-A13/MF-A01

EPA Form 2220-1 (9-73)

PB 291178

Post Secondary
Education Profile

COMPOSITE I
(Environmental Engineering/Health)

Phase II
Of A National Environmental/Energy Workforce Assessment

Conducted by:

NATIONAL FIELD RESEARCH CENTER, INC.
P. O. Box 287
Iowa City, Iowa 52240

REPRODUCED BY
NATIONAL TECHNICAL
INFORMATION SERVICE
U. S. DEPARTMENT OF COMMERCE
SPRINGFIELD, VA. 22161

NATIONAL ENVIRONMENTAL/ENERGY WORKFORCE ASSESSMENT

PHASE II

POST-SECONDARY EDUCATION PROFILE

COMPOSITE I

(Environmental Engineering/Health)

Conducted by:

NATIONAL FIELD RESEARCH CENTER, INC.

Under Grant from:

UNITED STATES

ENVIRONMENTAL PROTECTION AGENCY

Grant #T900591

1978

This document has been reviewed by the Environmental Protection Agency and approved for publication. Approval does not signify that the contents necessarily reflect the views and policies of the Environmental Protection Agency, nor does mention of trade names or commercial products constitute endorsement or recommendation for use.

National
Field
Research
Center, Inc.

P.O. BOX 287 IOWA CITY, IA 52240 (319) 351-8789

HEADQUARTERS

- IOWA CITY -
P.O. BOX 287
IOWA CITY, IA 52240
(319) 351-8789

FIELD OFFICES

- ATLANTA -
2700 CUMBERLAND PKWY
SUITE 150
ATLANTA, GA 30339
(404) 433-2644

- DENVER -
2600 S. PARKER ROAD
SUITE 160, NO. 6
DENVER, CO 80232
(303) 751-4962

- WASHINGTON, D.C. -
1522 K STREET, N.W.
SUITE 600
WASHINGTON, DC 20005
(202) 223-9136

AFFILIATE OFFICES

- CHICAGO -
P.O. BOX 57A
WHEELING, IL 60090
(312) 537-8988

- SPRINGFIELD -
22 DOWNING DRIVE
CHATHAM, IL 62629
(217) 483-2751

INTRODUCTORY NOTE

The National Environmental/Energy Workforce Assessment: Post-Secondary Education Profile was conducted by National Field Research Center, Inc. with main offices in Iowa City, Iowa. The following personnel have had primary responsibility for the development of the project report.

IOWA CITY, IOWA
    Dr. Darold E. Albright, President
    Paul E. Bridges, Executive Director
    D. Peter Wahl, Project Director
    Janet M. Henry
    Amy W. Mook
    Mary Kay (Edge) Wade

ATLANTA, GEORGIA
    Elizabeth G. Nielsen, Regional Director
    Marilyn J. Horton

DENVER, COLORADO
    Nancy C. Dillenberg, Regional Director
    Bruce D. Boxer

WASHINGTON, D.C.
    Frank E. Smith, Project Coordinator
    Jack F. Seum, Regional Director
    Robert D. Oxberger
    Dr. Constance Swank

Additional research and clerical assistance was provided by Margaret Fehn, Barbara Friedman, Cynthia Fruendt, Gail Gronlund, Karen Kirchoff, Sharon Leiker and Mary McCormac.

TABLE OF CONTENTS

Page

TABLES iv

ACKNOWLEDGEMENT. v

REVIEW COMMITTEE vi

FOREWORD viii

COMPOSITE SUMMARY. ix

PROJECT BACKGROUND 1

INTRODUCTION 9

PROJECT FINDINGS 43

I. A SUMMARY PROFILE OF REPRESENTATIVE COMPOSITE ENGINEERING/HEALTH EDUCATIONAL PROGRAMS

A. States, Institutions, Programs, and Degrees . . . 45
B. Enrollment Statistics and Graduates 46
C. Student Origin. 46
D. Employment and Environmental Occupations. 49
E. Graduate Follow-up. 52
F. Faculty 53
G. Internship/Applied Study Term 53

II. ADDITIONAL FINDINGS

A. Recruitment Techniques. 54
B. Sources of Student Support. 54
C. Research Funding. 55
D. Usage of ERIC and IRIS. 56
E. Program Flexibility 58
F. Communication and Financial Management Skills . . 58

III. TABLE 9 - A SUMMARY PROFILE OF REPRESENTATIVE COMPOSITE ENGINEERING/HEALTH TRAINING PROGRAMS. . . . 61

PROJECT COMMENTARY 89

LIST OF COMPOSITE ENGINEERING/HEALTH TRAINING INSTITUTIONS BY DEGREE. 97

COMPOSITE ENGINEERING/HEALTH TRAINING SUMMARIES. 101

APPENDICES 537

I. DEGREE ABBREVIATIONS. I-1

II. TERMINOLOGY II-1

III. SELECTED BIBLIOGRAPHY III-1

IV. PARTICIPATING INSTITUTIONS BY ENVIRONMENTAL CATEGORY. IV-1

V. COLLEGE CATALOGS REVIEWED V-1

DOCUMENT COMPLETE - PAGINATION PER SOURCE

TABLES

Table	Title	Page
1	Participating Institutions	13
2	Environmental Engineering/Health National Enrollment Profile	47
3	National Student-Origin Profile	48
4	Environmental Engineering/Health National Employment Profile	50
5	ERIC/IRIS Utilization Profile - Engineering/ Health	57
6	ERIC/IRIS Utilization Profile - National Summary	57
7	Time Required to Implement a Complete Content Change in a Course	59
8	Time Required to Implement a Complete Program Sequence	59
9	A Summary Profile of Representative Engineering/Health Programs	61

ACKNOWLEDGEMENT

Appreciation is extended to the many individuals, institutions, and organizations who generously contributed to the success of this national project. Of particular import are those contact persons listed in the program summaries. Their time and assistance in preparation, input and review represents the foundation upon which the National Environmental/Energy Workforce Assessment - Phase II rests.

Sincere appreciation is **expressed** to those persons within the United States Environmental Protection Agency, Office of Federal Activities, who provided guidance and direction throughout the term of the project: Mr. J. Donald Cook, Project Officer; Mr. Joseph McCabe, and Mr. Michael Moore. Special thanks are also extended to Mr. Tahlman Krumm, Ohio State University; and to Dr. Aleksander S. Vesic', Duke University (North Carolina).

Gratitude must be expressed to the many individuals and organizations from the private sector who were most generous in their contribution to this project. Their openness and responsiveness reflect their concern regarding the training of our environmental workforce and their critical role in that effort.

REVIEW COMMITTEE

A special word of acknowledgement is extended to the following people who graciously gave of their time, knowledge and experience in order to review and comment on the information included in this volume. The efforts of this national committee were particularly insightful, and in general have been incorporated into the final report.

It must be pointed out that in all cases the individuals acknowledged below were asked only to review and comment on the material contained in the volume and to express their views regarding the representativeness of the material presented. They were not asked to endorse either the volume or the study in general, and the inclusion of their name on this list should not be considered an endorsement since such was not the intent.

In light of numerous responsibilities, it is especially important to note that these persons responded within very strict time constraints. Such a pattern reflects positively on both the individuals and the institutions and organizations which they represent.

Dr. John L. Bové
Professor of Chemistry and Environmental
Engineering
The Cooper Union

Dr. Larry W. Canter
Director and Professor,
Civil Engineering and Environmental Science
University of Oklahoma

Dr. H. H. Cheng
Chairman and Professor of Environmental
Science
Washington State University

Dr. Sushil K. Gilotra
Professor and Chairman
Environmental Health Technology
Delgado College

Dr. Judith M. Schultz
Associate Professor of Biology
and Environmental Studies
University of Cincinnati - Raymond
Walters College

Mr. Rexford D. Singer
Associate Professor and Assistant
Director,
Environmental Health
University of Minnesota

FOREWORD

Information for this report was largely compiled from on-site interviews with professionals in post-secondary institutions throughout the United States. On-site interviews were supplemented by telephone and/or mail contact to clarify and revalidate the data. This report presents a summary of programs in junior colleges, vocational/technical training institutes, community colleges, four-year colleges, and universities as well as other training institutions. Programs are representative of all levels from academic certification through doctoral degrees. The environmental pollution control areas of air, noise, pesticides, potable water, radiation, solid waste, wastewater and energy were surveyed.

This study was conducted for the United States Environmental Protection Agency by the National Field Research Center, Inc. of Iowa City, Iowa, with field offices located in Atlanta, Georgia; Denver, Colorado; and Washington, D.C.

NATIONAL ENVIRONMENTAL/ENERGY WORKFORCE ASSESSMENT

PHASE II

POST-SECONDARY EDUCATION PROFILE

COMPOSITE SUMMARY

THE FOLLOWING PAGES PRESENT AN OVERVIEW, IN SUMMARY FORM, OF BOTH VOLUMES OF THE COMPOSITE REPORT. WHILE THE SUMMARY SYNOPSIZES ENGINEERING/HEALTH AND EDUCATION/ECOLOGY PROGRAM AREAS, INTERESTED READERS ARE ENCOURAGED TO REFER TO BOTH COMPOSITE VOLUME I (ENGINEERING/HEALTH) AND COMPOSITE VOLUME II (EDUCATION/ECOLOGY) FOR A MORE IN-DEPTH PRESENTATION OF PROGRAMS.

The Composite category accomodates those programs whose focus, structure, curriculum content, and specialized options indicate an overlapping emphasis in two or more environmental areas surveyed in Phase II or whose emphasis is environmentally related but not specific to any one area. This category is further divided into Engineering/Health and Education/Ecology sections; the former reflects a more technological emphasis while the latter integrates coursework in the natural, physical, and social sciences. This conceptual split in the composite category was intended to generate a more interpretable data base; however, the differences between the two sections are not substantial.

A. STATES, INSTITUTIONS, PROGRAMS, AND DEGREES

The Post-Secondary Education Profile (Phase II) surveyed 93 Engineering/Health programs in 32 states and 37 Education/Ecology programs in 17 states. In total, these programs represent a wide spectrum of degree offerings--from the diploma to the doctorate--and curriculum options. Given that 49 of the 93 institutions included in the composite sections offer more than one degree and 16 offer more than one environmental program, any list of schools surveyed in the Post-Secondary Inventory quantitatively represents many more curriculum opportunities than it suggests. The following table lists the number of programs surveyed by degree in the Composite category. For purposes of this summary, the Engineering/Health and Ecology/Education programs are combined.

Preceding page blank

COMPOSITE DEGREES, PROGRAMS, AND STATES

Degree	Number of Programs	States
Certificate (graduate level)	1	Alabama Alaska Arkansas California Connecticut Delaware District of Columbia Florida Georgia Indiana Iowa Kansas Kentucky Louisiana Maine Maryland Massachusetts Michigan Minnesota New Jersey New York North Carolina Ohio Oklahoma Pennsylvania South Carolina Tennessee Texas Utah Virginia Washington West Virginia Wisconsin
Diploma	1	
Associate	12	
Bachelors	38	
Masters	18	
Environmental Engineering	1	
Multiple Degree		
Cert/Asso/Bach/Mast/Doct	1	
Associate/Bachelors	2	
Bachelors/Masters	11	
Bachelors/Masters/Doctoral	15	
Masters/Doctoral	29	
Masters/Doctoral/Engineer	1	
TOTAL	130	33

B. ENROLLMENT STATISTICS AND GRADUATES

National summaries of enrollment and graduates per annum for the Composite programs surveys are reported in the following table. These data indicate that approximately three-fifths (58%) of the graduates in the Composite programs are awarded degrees at the bachelors level. The relative scarcity of sub-baccalaureate programs may in part be due to the four-year program requirements normally mandated in engineering and teacher training programs. Enrollment statistics indicate that 54%

NATIONAL COMPOSITE PROGRAMS

ENROLLMENT PROFILE SUMMARY

Degree	Enrollment		Graduates Average # Per Year	Enrollment Change by Program		
	Full-time	Part-time		Up	Down	Stable
Diploma	14	0	8	0	1	0
Associate	329	70	138	3	4	6
Bachelors	6,206	376	1,586	32	3	24
Masters	1,567	660	905	21	8	42
E.E.	4	12	9	0	1	1
Doctoral	279	76	104	10	5	31
TOTAL	8,399	1,194	2,750	66	22	104

of the Composite programs are experiencing stable enrollment and 34% are sustaining growth.

Percentages of in-state/out-of-state/foreign students show a fairly linear increase by degree level. That is to say, graduate programs have higher numbers of out-of-state and foreign students than undergraduate programs. This result is not surprising if one considers the capacity of the graduate programs--with their research facilities and tuition remission and assistantship plans--to attract students from a wider geographical radius.

Recruitment techniques are relatively standard across these composite programs and include posters, brochures, visits to local high schools, and campus career days. Those programs with extensive facilities, traineeships, or other curricular or financial attractions find such inducements facilitate recruitment. The effectiveness of any one method is difficult to assess across programs and is undoubtedly the function of many intervening variables.

C. FACULTY

A total of 992 (62%) full and 610 (38%) part-time members serve the 130 composite training programs surveyed. Of these, 832 (68%) full and 383 (32%) part-time faculty are associated with engineering/health programs and 169 (43%) full and 227 (58%) part-time faculty are working in education/ecology programs. In several programs, a number of departments supply faculty to teach various courses in the composite programs.

When asked how they remain current in their field, faculty responses were largely the same--journals, professional meetings, and consulting. A number of contact persons noted the difficulty of keeping abreast of the rapid changes in the environmental field and observed the need for periodic, easily obtainable up-dates on environmental research and regulations.

D. CURRICULA

Programs in the Engineering/Health section prepare students in at least two of the eight environmental areas surveyed in Phase II (air, energy, noise, pesticides, potable water, radiation, solid waste, and wastewater). The emphasis of the programs is primarily technical and/or scientific and, as reflected in the section heading, geared to environmental engineering and environmental health coursework. The Education/Ecology programs train students for social, educational, political, ecological, managerial, and sytems positions within the environmental workforce. The curricular emphases of both sections are not easily isolated, and the assignment of programs to a particular section is subjective.

Curriculum flexibility, as measured by the amount of time needed to implement a new course or program, gives some indication of the capacity of the educational community to meet changing employment needs. In response to questions regarding this flexibility, contact persons reported that new courses can usually be implemented in one month to one year while program changes may take slightly longer. Answers to these questions were often conditional and dependent on the availability of faculty time and financial resources, departmental and institutional support, and the preparation readiness of course syllabi and materials.

Contact persons made several comments on existing curriculum materials and suggestions for improving instructional aids. They noted that training materials are often "too specific or too general" or "too sophisticated for two-year training programs." Contact personnel asked for curriculum aids that integrate Environmental Studies subjects, more visual aids, and more laboratory equipment. There is some concern that some equipment purchased with federal grant monies must now be returned to the government upon completion of the grant, thus limiting the continuation of research projects.

A concern of professionals in the environmental workforce is that graduates are weak in communication and financial management skills.

Engineering/Health and Education/Ecology program personnel surveyed in Phase II basically agree with this assessment but argue that the same concern applies to all students regardless of discipline. Programs typically require some communication training (writing and speaking) in both formal and informal settings. Financial management skills are usually developed in less structured ways than actual coursework, and according to some contacts, are not necessary prerequisites for submanagerial employment.

To provide students with a practical working experience related to their classroom and laboratory training, 29% of the Engineering/Health and 59% of the Education/Ecology degree programs offer internships or applied study terms. These experiences not only prepare students for real-world employment but may facilitate job placement. Salaries paid for work under these instructional programs are also a means of financial aid.

E. RESEARCH FUNDING AND SOURCES OF STUDENT FINANCIAL SUPPORT

The financial stability of environmental programs is often a key to their success or demise. Monies for research and student financial aid enable programs to attract faculty and students. Federal and state agencies, private corporations, regional study commissions, and other entities provide important research funding to many of the programs surveyed in Phase II. Curriculum changes, additional faculty lines, laboratory materials, and salary increments cost money; and environmental programs are looking more and more to the federal government for support.

Student financial aid packages typically include scholarships; federal, state, and campus loan programs; college work study; and part-time employment outside the university. A majority of graduate students in many of the programs are employed by their departments as teaching or research assistants or as support personnel on program grants or contracts. Traineeships, such as those from the Environmental Protection Agency and the National Institute of Occupational Safety and Health, are an important means of support for those programs fortunate enough to receive them; many other contacts note the negative impact the loss of these traineeships has had on the stability of their programs.

F. EMPLOYMENT

Contact personnel were asked what percentage of their program graduates are employed in industry, consulting, government, or other fields (teaching positions, etc.). The following tables summarize these results nationally.

Industry and government appear to draw greater numbers of Engineering/Health and Education/Ecology program graduates than do consulting firms and various educational institutions. The high percentage of graduates entering government work is not surprising given the emphasis placed on environmental regulation, assessment, and protection by the public sector. Likewise, government mandates have forced industry to take steps in combating pollution and precipitated employment opportunities in this area. Declines in public school enrollment and fiscal constraints at all levels have contributed to decreasing numbers of jobs in the educational community.

COMPOSITE PROGRAMS

NATIONAL EMPLOYMENT PROFILE

Degree	Private Sector Industry	 Consulting	 Total	Government	Other
Diploma	1%	0%	1%	99%	0%
Associate	32%	11%	43%	54%	2%
Bachelors	34%	12%	46%	42%	11%
Masters	26%	23%	49%	38%	13%
E.E.	58%	11%	69%	27%	3%
Doctoral	27%	28%	55%	31%	14%
TOTAL	31%	16%	47%	41%	12%

In an attempt to identify more specifically those occupations which Engineering/Health and Education/Ecology graduates are qualified to fill, survey participants were asked to check on a prepared form those jobs that graduates of a given degree are trained to assume. Occupations most often cited were:

Composite

Degree Level	Occupations
Certificate	Air Pollution Control Technician
	Environmental Monitoring Specialist
	Regulatory Specialist
	Sanitary Technician
	Solid Waste Collection Operator
	Vector Control Specialist
Associate	Biological Technician
	Environmental Tester/Analyst
	Sanitary Technician
Bachelors	Ecologist
	Environmental Engineering (Water Pollution Control) (Water Resources)
	Environmental Science Technician
	Industrial Waste Inspector
Masters	Chemist
	Environmental Engineer (Water Pollution Control) (Water Resources)
	Pollution Control Specialist
	Sanitary Engineer
Environmental Engineering	Air Pollution Analyst
	Air Pollution Control Engineer
	Environmental Control Engineer
	Environmental Engineer (Water Pollution Control) (Water Resources)
Doctoral	Aerosol Physicist
	Aquatic Biologist
	Bacteriologist
	Chemist
	Environmental Engineer (Water Pollution Control)
	Microbiologist
	Pollution Control Specialist

PROJECT BACKGROUND

Photo reprinted from the University of Wisconsin,
Madison Oceanography and Limnology Catalog

PROJECT BACKGROUND

OVERVIEW:

In late 1975, Congress acknowledged the growing national concern for the preservation and conservation of our national resources with a direct inquiry into the availability and readiness of our environmental workforce. That inquiry has taken the form of a three-year, three-phase National Environmental/Energy Workforce Assessment, currently being conducted by National Field Research Center under the direction of the U.S. Environmental Protection Agency. In keeping with the objective of the assessment, this three-phase national effort directs itself at environmental/energy workforce needs, national educational preparedness, and the functional relationship between the two.

PHASE I:

Phase I of the National Environmental/Energy Workforce Assessment focused upon the development of "workforce demand projections" through 1982 for all public environmental agencies. This on-site assessment, which was carried out in all 50 states, Puerto Rico and the Virgin Islands, culminated in a numerical profile of the growth patterns and workforce needs at the national and state levels. Stratification of the overall definition of "environmental occupation" into seven distinct vocational areas enhanced even further the applicability of the results. In addition to this public sector workforce assessment, Phase I included an overview analysis of private sector needs (through an adjunct mail survey of selected businesses and industries) and a brief review of selected environmental educational programs.

Phase I was completed in May, 1977. The 70-volume final report included:

* National Abstract	(1)
* National Legislation	(1)
* Regional Assessments	(10)
* State Assessments (including D.C., VI and PR)	(53)
* Business and Industry Assessment	(1)
* National Summary	(4)

PHASE II:

Phase II of the National Environmental/Energy Workforce Assessment was structured around an intensive on-site inventory of representative environmental educational offerings on a national scale. The primary objective of this project has been to collect and aggregate data on training and educational programs in both the post-secondary education field and in the private sector and to do so by environmental area. Specifically, the study was designed to provide an overview of environmentally related post-secondary education programs, their program structure, representative course offerings, employment history of the graduates, and the faculty structure. Additionally, information was to be collected on program requirements and program projections.

Initially, opportunities to nominate programs for inclusion in this on-site review process was given to the Environmental Protection Agency and its program officers and regional personnel both through the

Project Officer and via direct mail requests; all state departments of education; state environmental agencies and selected media-specific associations. These nominations were supplemented by a direct review of institutional catalogs, information obtained during the first year's on-site activities, and a review of other published sources of information regarding degree programs in environmental areas. These sources are included in Appendix III - Selected Bibliography.

Following their initial development, the lists of nominees were forwarded to the program officers for suggestions regarding additions or deletions. Next, letters were written to those nominated institutions seeking their support and cooperation in the on-site review process. Several programs, some of which were highly recommended, declined the opportunity to participate giving reasons varying from lack of time to the fact that the program being inquired about no longer existed, to outright refusal to cooperate with any government study. These institutions were deleted from the final on-site process. The remainder were included in the study and are shown in Table 1 of each volume. Selection of the sample for the private sector is discussed in depth in that particular volume.

In preparation for the on-site interviews, appropriate persons were contacted in the institution involved and were given a background description of the study, a suggested timetable for the interview process and were told what kind of information was being sought. This was all done in an effort to keep the time involvement of the individual contact persons at a minimum. During the actual on-site interview, generally lasting around one hour, the information was collected, questions asked and answered, and further informational contacts identified. Following this process, each on-site interview was written up in the form of a Training Program Summary, which where time allowed, was returned to the contact person for critiquing prior to inclusion in the report.

Throughout this process, individuals and institutions were given assurance that this study was not an attempt to evaluate program offerings and every attempt has been made on the part of the writers to live up to this assurance. Inclusion in this report provides no assurances of quality, nor should a program's exclusion be consideration of the lack thereof. In many instances certain programs within an institution were not included while others were, primarily due to the determination of the sample - previously discussed. This too should not be viewed in any qualitative manner.

REPORT ORGANIZATION:

The final report, of which this volume is a part, consists of volumes depicting a training profile in each medium under consideration, namely,

Air
Energy
Noise
Pesticides
Potable Water
Radiation
Solid Waste
Wastewater
Composite
Business and Industry and Trade Associations

At the outset it should be pointed out that there are very few degree programs conveying degrees in a particular medium; rather, degrees are offered in various specialties which lend themselves to obtaining employment in one or more of these fields. Nonetheless, to obtain maximum utility for the funding agency, programs were reported in this fashion. The Composite section was necessitated by the number of programs offering course work in multiple fields and differing specializations resulting from course selection. For convenience in handling of the data Potable Water, Wastewater and Composite have been reported in multiple volumes because of the numbers involved. Although separated into volumes either by degree level of the programs involved, as in the case of Potable Water and Wastewater, or by content as in the case of Composite, persons interested in any of these fields would be well advised to review each of the volumes to assure more complete coverage.

Along with the standard introductory pages common to volumes of this nature, each volume contains sections on Project Background, Introduction (consisting of sections devoted to a description of the programs surveyed and covered in the volume), Project Commentary, and the Training Summaries along with the Appendices.

REVIEW PROCESS:

In addition to individual training summary reviews conducted by the persons initially interviewed, each volume has been reviewed internally, by persons in the Environmental Protection Agency and by a select group of review committee members. In the final instance, individuals met during the on-site process were nominated by interviewers for inclusion on the review committee, primarily as a result of their obvious expertise in the field and their evidenced interest in the project.

These persons were then contacted by mail or by telephone in an effort to determine their willingness to serve. The rather stringent timelines necessary to keep the project on course and to deliver the finished product as specified were also detailed. In excess of one hundred persons returned their volumes (out of a mailing of 120) and all but five of these provided usable responses. In these five instances either last minute job demands prevented them from carrying out the review in the short timelines, or (in two instances) individuals indicated that they wanted nothing to do with the process. This particular method of review provided a wealth of valuable information, suggestions for revision of specific elements, and general comments helpful in revising the final documents. In all cases an effort was made to seriously consider and incorporate reviewer suggestions. The persons on the various review committees are individually acknowledged in the front of the volume they reviewed.

Photo reprinted from the University of Missouri, Columbia Bulletin 1977.

INTRODUCTION

Photo reprinted from the Northland College Catalog 1975-76

INTRODUCTION

Phase II of the National Environmental/Energy Workforce Assessment Project was designed to survey the capability of the educational community to generate an environmental workforce. The resulting Post-Secondary Education Profile identified and gathered information concerning representative training programs in a variety of environmental areas: air, energy, noise, pesticides, potable water, radiation, solid waste, and wastewater. At the onset, it became readily apparent that some environmental programs do not fit neatly into any single category: they may fit more than one or none at all. Nonetheless, these programs produce environmentally aware and environmentally skilled graduates who then enter our national workforce. In order to include these unique or umbrella programs, a category labeled COMPOSITE was created.

Subsequent review of the structure, objectives and goals, and course requirements and descriptions for each composite program suggested the feasibility of further dividing these programs into two sections. The first volume--Environmental Engineering/Health--contains those programs which prepare students for predominately technical, engineering, or environmental health occupations. Curriculum options, areas of specialization or concentration, and coursework, by the very nature of the composite designation, reflect at least two of the environmental areas surveyed in this Workforce Assessment Project. The second section--Environmental Education/Ecology--contains programs that train students for social, educational, political, ecological, managerial, and systems positions within the environmental workforce. While students enrolled in these Education/Ecology programs may receive extensive technical training, their plans of study incorporate the social and behavioral sciences, resource management and policy, and training in the integration of disciplines in solving environmental problems.

The sectional placement of a given composite program was essentially based on a subjective assessment of that program's commonality with other programs in Engineering/Health and in Education/Ecology. As such, the identification of programs as either Engineering/Health or Education/Ecology is subject to question. The purpose of dividing these composite programs, however, was not to attain a high degree of inter-rater reliability but to permit a potentially more interpretable data set. For a more complete understanding of the type of programs included in each composite section, one should consult the individual program summaries contained in the two volumes titled Engineering/Health and the single volume titled Education/Ecology.

Given these definitional considerations, the survey responses from contact personnel in Environmental Education/Ecology programs regarding student enrollment and recruitment, employment and follow-up of graduates, research activity and support, faculty numbers, curriculum projections, and funding needs are presented and discussed in the pages that follow. Responses are compiled nationally, and by degree level. While sample size and sampling error limit the generalizability of these results, some attempt is made to summarize the general implications of the project for training programs in Environmental Education, Ecology, and related areas.

TABLE I

PARTICIPATING INSTITUTIONS

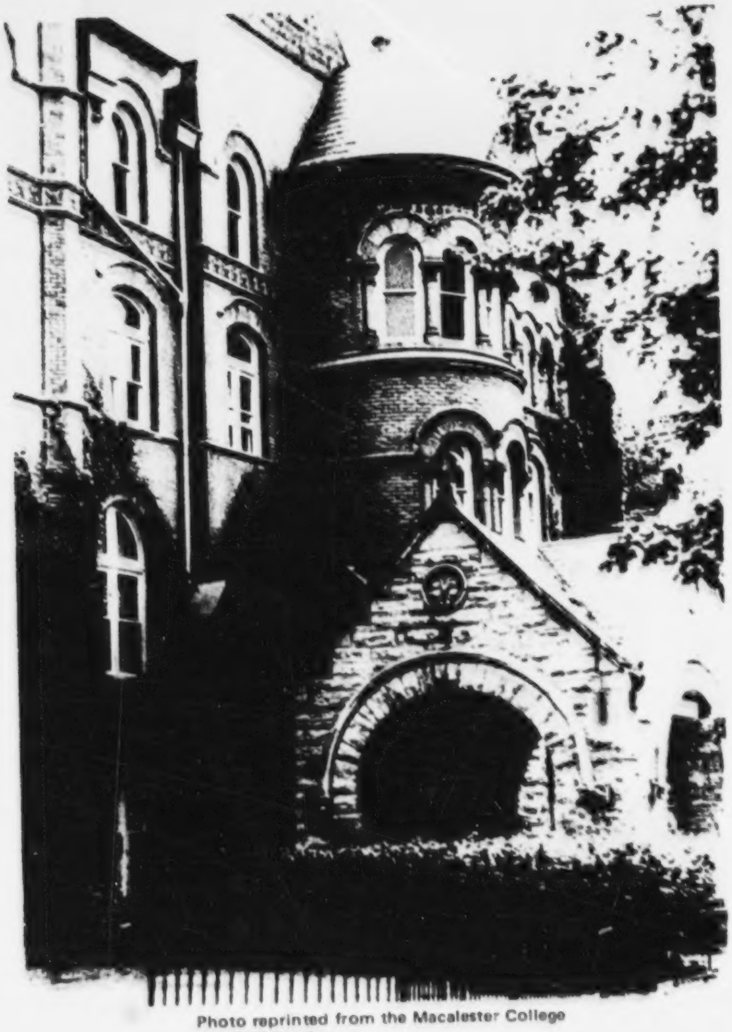


Photo reprinted from the Macalester College
1976-78 Catalog

Table 1 is a comprehensive listing of all institutions which participated in the post-secondary educational profile of the National Environmental/Energy Workforce Assessment. Listed by state, institution, and degree are programs surveyed in the areas of air, energy, noise, pesticides, potable water, radiation, solid waste and wastewater.

An explanation of the degree abbreviations utilized within the report may be found in Appendix I, entitled "Degree Abbreviations". For a complete listing of the institutions visited in a media specific area (i.e., air, energy, etc.), attention is drawn to Appendix IV, entitled "Participating Institutions by Environmental Category".

The Table in part III of the Project Findings, entitled "A Summary Profile of Representative Educational Programs" follows the narrative and is a presentation of specific institutions visited for the particular volume.

TABLE I

PARTICIPATING INSTITUTIONS

STATE	INSTITUTION	PROGRAM TITLE	DEGREE(S)*
AL	University of Alabama University	Environmental Engineering	M.S. (3)
AK	University of Alaska Fairbanks	Environmental Quality Engineering Science	M.S.
AR	University of Arkansas Fayetteville	Agricultural Engineering	B.S. M.S. Ph.D.
		Civil Engineering	M.S.C.E.
		Environmental Engineering	M.S.En.E.
		Environmental Science	B.S.
CA	California Institute of Technology Pasadena	Environmental Engineering Science	M.S. Ph.D.
	California Polytechnic State University San Luis Obispo	Environmental Engineering	B.S.
	California State University-Sacramento Sacramento	Civil and Environmental Engineering	B.S. M.S.
	Stanford University Stanford	Environmental and Water Studies	M.S. Ph.D.
	University of California-Berkeley Berkeley	Nuclear Engineering	B.S. M.S. M.E. Ph.D. D.E.
		Pest Management	B.S.
		Sanitary Engineering	M.S. M.E. Ph.D.
	University of California-Davis Davis	Environmental Toxicology	B.S.
		Plant Protection and Pest Management	M.S.

TABLE I

PARTICIPATING INSTITUTIONS

STATE	INSTITUTION	PROGRAM TITLE	DEGREE(S)
	University of California-Davis (Cont'd)	Entomology	B.S. M.S. Ph.D.
	University of California-Riverside Riverside	Pest Management	M.S.
	University of California-Santa Barbara Santa Barbara	Environmental Studies	B.A.
CO	Colorado State University Fort Collins	Environmental Engineering (Civil)	M.S. Ph.D.
	Community College of Denver-Red Rocks Golden	Water-Wastewater Technology	A.A.
CT	Hartford State Technical College Hartford	Nuclear Engineering Technology	A.S.
	Yale University New Haven	Environmental Health	M.P.H.
DE	Delaware Technical and Community College Newark	Environmental Engineering Technology	A.A.S.
	University of Delaware Newark	Entomology and Applied Ecology	B.S.
		Environmental Engineering	M.A.S. M.E. Ph.D.(App. Science) Ph.D.(ChE)
DC	Catholic University Washington	Civil Engineering	B.S.
	Howard University	Environmental Engineering	M.E.

TABLE I

PARTICIPATING INSTITUTIONS

STATE	INSTITUTION	PROGRAM TITLE	DEGREE(S)
FL	Broward Community College Fort Lauderdale	Pest Control Technology	A.S.
	Central Florida Community College Ocala	Radiological Health Technology	A.S.
	Florida International University Miami	Environmental Studies	B.A. B.S.
		Environmental Engineering Technology	B.S.
	Heed University Hollywood	Ocean and Environmental Affairs	M.A. Ph.D.
	Miami-Dade Community College Miami	Environmental Engineering Technology	A.S.
		Marine Science Technology	A.S.
	University of Florida Gainesville	Air Pollution	M.E. M.S. Engineer Ph.D.
		Environmental Biology	M.E. M.S. Engineer Ph.D.
		Environmental Resources Management Activities	M.E. M.S. Engineer Ph.D.
		Systems Ecology	M.E. M.S. Engineer Ph.D.

TABLE I

PARTICIPATING INSTITUTIONS

STATE	INSTITUTION	PROGRAM TITLE	DEGREE(S)
	University of Florida (Cont'd)	Water Supply and Water Pollution Control	M.E. M.S. Engineer Ph.D.
		Nuclear Engineering	B.S.(N.E.) B.S.E.(N.E.) M.E. M.S. Engineer Ph.D.
		Radiological Sciences	M.E. M.S.
	University of Miami Miami	Marine and Atmospheric . Science	M.S. Ph.D.
GA	Abraham Baldwin Agricultural College Tifton	Plant Protection	A.Ag.
	Atlanta University Center/ Georgia Institute of Technology Atlanta	Water Pollution Control Design Engineering	B.S. B.E.
	Georgia Institute of Technology Atlanta	Acoustical Engineering	Advanced Cert.
		Energy Engineering	Advanced Cert.
		Environmental Studies	Advanced Cert.
	Southern Technical Institute Marietta	Nuclear Safety	A.S.
	University of Georgia Athens	Entomology	B.S. A.B. M.S. M.P.P.P.M. Ph.D.

TABLE I

PARTICIPATING INSTITUTIONS

STATE	INSTITUTION	PROGRAM TITLE	DEGREE(S)
	University of Georgia (Cont'd)	Environmental Health Science	B.S.E.H.
HI	University of Hawaii Honolulu	Environmental and Sanitary Engineering	M.S.
IL	Illinois Institute of Technology Chicago	Environmental Engineering	B.S.E.S. M.S. Ph.D.
	Prairie State Community College Chicago Heights	Air, Water, Wastewater	A.A.S.
	Sangamon State University Springfield	Environments and People	B.A. M.A.
	Southern Illinois University-Edwardsville Edwardsville	Wastewater Treatment Operator Training	Cert.
IN	Indiana University Bloomington	Environmental Programs	Cert. A.S. B.A. B.S. M.P.A. M.S.E.S. Ph.D. (minor)
	Purdue University West Lafayette	Environmental Sciences Option	B.S.
		Nuclear Engineering	B.S.N.E. M.S. Ph.D.
IA	Iowa State University Ames	Environmental Studies	B.A. B.S.
		Sanitary Engineering and Water Resources	M.S. Ph.D.

TABLE I

PARTICIPATING INSTITUTIONS

STATE	INSTITUTION	PROGRAM TITLE	DEGREE(S)
	Kirkwood Community College Cedar Rapids	Environmental Health Assistant	Diploma
		Environmental Health Technician	A.A.
		Water and Wastewater	Diploma
	University of Iowa Iowa City	Environmental Engineering	M.S. Ph.D.
		Environmental Toxicology	M.S. Ph.D.
KS	Kansas State University Manhattan	Chemical Engineering	B.S. M.S. Ph.D.
		Mechanical Engineering	B.S. M.S. Ph.D.
		Nuclear Engineering	B.S. M.S. Ph.D.
		Sanitary Engineering	M.S.C.E.
	University of Kansas Lawrence	Environmental Health Engineering	M.S. Ph.D.
		Environmental Health Science	M.S. Ph.D.
		Environmental Studies	B.A.
		Radiation Biophysics	B.A. B.S. M.S. Ph.D.
		Water Resources Engineering and Science	M.S. Ph.D.

TABLE I

PARTICIPATING INSTITUTIONS

STATE	INSTITUTION	PROGRAM TITLE	DEGREE(S)
KY	Morehead State University Morehead	Environmental Studies	B.S. A.B.
		Mining Technology	A.A.S.
	Pikeville College Pikeville	Mining Technology	A.M.T.
	University of Kentucky Lexington	Energy (Coal) Engineering	M.S. Ph.D.
		Environmental Engineering	M.S. Ph.D.
	University of Louisville Louisville	Environmental Engineering	B.S. M.Eng.
	Western Kentucky University Bowling Green	Environmental Science	B.S.
		Environmental Engineering	B.S.
LA	Delgado College New Orleans	Urban Pest Management	A.S.
		Water/Wastewater Technology	A.S.
		Environmental Health Technology	A.S.
	McNeese State University Lake Charles	Environmental Science	B.S. M.S.
ME	Eastern Maine Vocational Technical Institute Bangor	Environmental Control Technology	A.A.S.
	New England Regional Wastewater Institute (S. Maine Vocational Technical Institute) S. Portland	Wastewater Treatment Technology	Cert.

TABLE I

PARTICIPATING INSTITUTIONS

STATE	INSTITUTION	PROGRAM TITLE	DEGREE(S)
	University of Maine-Orono Orono	Sanitary Engineering	M.S.C.E. Ph.D.
MD	Charles County Community College La Plata	Pollution Abatement Technology	A.A.
	Johns Hopkins University Baltimore	Environmental Engineering	M.A. M.S.E. M.S. Ph.D
	University of Maryland College Park	Environmental Engineering	M.S.
		Nuclear Engineering	M.S.
		Pest Management	M.S.
MA	Harvard University Cambridge	Environmental Health Sciences	S.M. Sc.D.
		Environmental Sciences and Engineering	S.M. M.E. Ph.D.
		Toxicology	S.M. Sc.D.
	Massachusetts Institute of Technology Cambridge	Acoustics	S.M. Sc.D./ Ph.D.
		Environmental Engineering	Env.E.
		Mineral Resources Engineering and Management	S.M. Engr. Sc.D./ Ph.D.

TABLE I

PARTICIPATING INSTITUTIONS

STATE	INSTITUTION	PROGRAM TITLE	DEGREE(S)
	Massachusetts Institute of Technology (Cont'd)	Nuclear Engineering	S.B. S.M. N.E. Sc.D./ Ph.D.
		Water Resources and Environmental Engineering	S.B. S.M. Sc.D./ Ph.D.
		Wastewater Treatment Plant Operations	Cert.
	Northeastern University Boston	Environmental Engineering and Science	M.S.
	Springfield Technical Community College Springfield	Environmental Technician	A.S.
	Tufts University Medford	Environmental Health Engineering	B.S.C.E. M.S.
	University of Lowell Lowell	Radiological Health Physics/Radiological Sciences and Protection	B.S. M.S.
		Wastewater Treatment Plant Operations	Cert.
MI	Ferris State College Big Rapids	Environmental Health Technician	A.A.S.
		Environmental Health	B.S.
	Michigan State University East Lansing	Environmental Conservation Education	M.S. Ph.D.
		Environmental Engineering	B.S.C.E. M.S. (emphasis) Ph.D. (emphasis)

TABLE I

PARTICIPATING INSTITUTIONS

STATE	INSTITUTION	PROGRAM TITLE	DEGREE(S)
	Michigan State University (Cont'd)	Natural Resources and Environmental Education	B.S.
		Systems Science (Ecological Systems)	B.S. M.S. Ph.D.
	Michigan Technological University Houghton	Environmental Engineering	B.S.C.E. B.S.E. M.S.C.E.
	University of Michigan Ann Arbor	Environmental Education	M.S.
		Environmental Sciences Engineering	B.S.
		Industrial Hygiene and Air Pollution	M.P.H. M.S. Dr.P.H. Ph.D.
		Radiological Health	M.P.H. M.S. Dr.P.H. Ph.D.
		Water Resources: Engineering	M.S.E. Ph.D.
		Management Science	M.S. Ph.D.
		Water Quality	M.P.H. M.S. Dr.P.H. Ph.D.
MN	Bemedji State College Bemedji	Environmental Studies	B.S. M.A.
	Macalester College St. Paul	Environmental Studies	B.A. B.S.
	University of Minnesota Minneapolis	Environmental Health	M.P.H. M.S. Ph.D.

TABLE I

PARTICIPATING INSTITUTIONS

STATE	INSTITUTION	PROGRAM TITLE	DEGREE(S)
MS	Mississippi State University Mississippi State	Specialized Training in Pest Management	M.Ag.
MO	Missouri Southern State College Joplin	Environmental Health Technology	A.S. B.S.
		Radiologic Technology	A.S.
	St. Louis Community College at Forest Park St. Louis	Radiologic Technology	A.S.
	University of Missouri-Columbia Columbia	Sanitary Engineering	B.S. M.S. Ph.D.
	University of Missouri-Rolla Rolla	Environmental and Sanitary Engineering	M.S. Ph.D.
	Water and Wastewater Technical School Neosho	Water and Wastewater Training	Cert.
	Washington University St. Louis	Air (emphasis)	M.S. D.Sc.
MT	Montana State University Bozeman	Environmental Engineering	M.S.
		Environmental Health Technology	M.S.
	Northern Montana College Havre	Environmental Health Technology	A.A. Cert.
NE	Central Technical Community College Hastings	Agriculture Technology	Cert. 1-Year Diploma 2-Year Diploma A.A.S. A.S.

TABLE I

PARTICIPATING INSTITUTIONS

STATE	INSTITUTION	PROGRAM TITLE	DEGREE(S)
	University of Nebraska Lincoln	Sanitary Engineering	B.S. M.S. Ph.D.
		Water Resources Engineering	M.S.
		Planning and Management	M.S.
NH	University of New Hampshire Durham	Entomology	B.S. B.A.
NJ	Middlesex County College Edison	Environmental Health Science Technology	A.A.S.
	New Jersey Institute of Technology Newark	Interdisciplinary Studies in Environmental Engineering	M.S.
	Princeton University Princeton	Energy Conversion and Resources	Topical Programs
	Rutgers-SUNJ New Brunswick	Biology (option in entomology)	B.S. B.A.
		Entomology and Economic Zoology	M.S. M.P. Ph.D.
		Environmental and Business Economics	B.S.
		Environmental Science	M.S. Ph.D.
		Environmental Studies	B.S.
		Environmental and Water Resources Engineering	M.S. Ph.D.
		International Environmental Studies	B.A. B.S.

TABLE I

PARTICIPATING INSTITUTIONS

STATE	INSTITUTION	PROGRAM TITLE	DEGREE(S)
	Rutgers-SUNJ (Cont'd)	Radiation Sciences	M.S. Ph.D.
	Stevens Institute of Technology Hoboken	Air Pollution Control Engineering	Cert.
		Water and Wastewater Engineering	Cert.
NM	New Mexico State University Las Cruces	Pest Management	B.S.
	University of New Mexico Albuquerque	Nuclear Engineering	M.S. Ph.D.
NY	Clarkson College Potsdam	Civil and Environmental Engineering	B.S. M.S.
	Columbia University New York City	Nuclear Engineering	B.S. M.S. Nuc.Engr. Eng.Sc.D.
	Cornell University Ithaca	College Program in Energy Conversion	B.S.
		Environmental Engineering	B.S. M.S. M.Eng. Ph.D.
		Waste Management Engineering	M.S. M.Eng. M.P.S. Ph.D.
		Nuclear Engineering	M.Eng. M.S. Ph.D.
	Hofstra University Hempstead	Solid Waste Management	Cert.
	Hudson Valley Community College Troy	Public Health Technology (Environmental option)	A.A.S.

TABLE I

PARTICIPATING INSTITUTIONS

STATE	INSTITUTION	PROGRAM TITLE	DEGREE(S)
	Hunter College New York City	Environmental Health Science	B.S. M.S.
	Manhattan College New York City	Environmental Engineering and Science	M.S. M.E.
	Polytechnic Institute of New York New York City	Energy Engineering and Policy	Cert. M.S.
		Environmental Engineering and Planning	M.S.C.E. M.E.H.S. Engr. Ph.D.
	Rensselaer Polytechnic Institute Troy	Environmental Engineering	B.S. M.E. M.S. D.E. Ph.D.
		Nuclear Engineering	B.S. M.S. M.E. Ph.D.
	Rochester Institute of Technology Rochester	Civil Engineering Technology (Environmental option)	B.T.
	State University of New York-Buffalo Buffalo	Water Resources and Environmental Engineering	B.S. M.S. Ph.D.
	State University of New York Farmingdale	Pest Control Technology	A.A.S.
	Syracuse University Syracuse	Chemical Engineering	B.S. M.S. Ph.D.
		Environmental Engineering	B.S.
		Sanitary Engineering, Sanitary Science, Civil Engineering	M.S.(S.E.) M.S.(S.S.) Ph.D.

TABLE I

PARTICIPATING INSTITUTIONS

STATE	INSTITUTION	PROGRAM TITLE	DEGREE(S)
	The Cooper Union New York City	Integrated Master's Program with concentration in Environmental Engineering	M.E.
	Ulster County Community College Stone Ridge	Water Quality Management Training	A.A.S.
	University of Rochester Rochester	Toxicology Training Program	M.S. Ph.D.
NC	Duke University Durham	Environmental Management	M.E.M.
		Civil Engineering/ Urban and Environmental Engineering	M.S. Ph.D.
	North Carolina State University Raleigh	Agricultural Pest Control	A.A.S.
		Pest Management	B.S. M.S. (minor)
		Air Conservation	M.S. (minor) M.E. (minor) Ph.D.(minor)
		Environmental Engineering	M.S. M.C.E. Ph.D.
		Acoustic, Noise Vibration	M.S. M.M.E. Ph.D.
	University of North Carolina Chapel Hill	Air and Industrial Hygiene	M.S. M.S.P.H.
		Environmental Chemistry and Biology	M.S. M.S.P.H. Ph.D.

TABLE I

PARTICIPATING INSTITUTIONS

STATE	INSTITUTION	PROGRAM TITLE	DEGREE(S)
	University of North Carolina (Cont'd)	Environmental Management Protection	M.S. M.S.P.H. Ph.D.
		Radiological Hygiene	M.S. M.S.P.H. Ph.D.
		Water Resources Engineering	M.S. M.S.P.H. M.S.E.E. Ph.D.
	Wilson County Technical Institute Wilson	Sanitary Landfill Operating Manager	Cert. Diploma A.A.S.
		Sanitary Landfill Technology	A.A.S.
ND	North Dakota State School of Science Wahpeton	Environmental Science Technology	A.A.
OH	Antioch College Yellow Springs	Environmental Studies	B.S.
	Hocking Technical College Nelsonville	Environmental Health Technology	A.A.S.
	Miami University Oxford	Environmental Science	M.En.
	Muskingum Area Technical College Zanesville	Environmental Quality Control Technology	A.A.S.
		Natural Resources Conservation Technology	A.A.S.
		Petroleum Engineering Technology	1-Year Cert. A.A.S.
	Ohio State University Columbus	Agricultural Engineering	B.S. M.S. Ph.D.

TABLE I

PARTICIPATING INSTITUTIONS

STATE	INSTITUTION	PROGRAM TITLE	DEGREE(S)
	Ohio State University (Cont'd)	Chemical Engineering (air)	B.S. M.S. Ph.D.
		Civil Engineering	B.S. M.S. Ph.D.
		Environmental Biology	M.S. Ph.D.
		Environmental Education	B.S.(Ed.) B.S.(N.R.) M.S. Ph.D.
		Toxicology (Pharmacology)	M.S. Ph.D.
	Ohio University Athens	Environmental Studies	M.S.
	Raymond Walters General and Technical College (University of Cincinnati) Cincinnati	Environmental Control/ Protection Technology	A.S.
	University of Cincinnati Cincinnati	Air Pollution and Industrial Hygiene	M.S. Ph.D.
		Civil and Environmental Engineering	M.S. Ph.D.
		Environmental Health	M.S. Ph.D.
		Mechanical and Industrial Engineering (noise)	B.S. M.S. Ph.D.
		Occupational Medicine	M.S. Ph.D.
		Toxicology	M.S. Ph.D.

TABLE I

PARTICIPATING INSTITUTIONS

STATE	INSTITUTION	PROGRAM TITLE	DEGREE(S)
	University of Cincinnati (Cont'd)	Acoustics and Noise Control	B.S. M.S. Ph.D.
	University of Toledo Toledo	Chemical Engineering, Civil Engineering	B.S. M.S.
		Engineering Science	M.S.
OK	East Central Oklahoma State University Ada	Environmental Science	B.S.
	OSU Oklahoma City Technical Institute Oklahoma City	Civil Technology	A.S.
	Oklahoma State University Stillwater	Engineering Technology	A.D. B.S.
		Radiation and Nuclear Engineering Technology	A.D. B.S.
	Oscar Rose Junior College Midwest City	Wastewater Technology	A.A.S.
		Environmental Science	A.A.S.
	University of Oklahoma Norman	Environmental Science	B.S. M.S. Ph.D.
OR	Linn-Benton Community College Albany	Wastewater Technology	A.S.
		Water/Wastewater Technology	A.S.
		Water/Wastewater Plant Operator	Cert.
	Oregon Institute of Technology Klamath Falls	Environmental Technology	A.A.S. B.T.
	Oregon State University Corvallis	Nuclear Engineering Technology	B.S.
		Nuclear Engineering	B.S. M.S.

TABLE I

PARTICIPATING INSTITUTIONS

STATE	INSTITUTION	PROGRAM TITLE	DEGREE(S)
	University of Cincinnati (Cont'd)	Acoustics and Noise Control	B.S. M.S. Ph.D.
	University of Toledo Toledo	Chemical Engineering, Civil Engineering	B.S. M.S.
		Engineering Science	M.S.
OK	East Central Oklahoma State University Ada	Environmental Science	B.S.
	OSU Oklahoma City Technical Institute Oklahoma City	Civil Technology	A.S.
	Oklahoma State University Stillwater	Engineering Technology	A.D. B.S.
		Radiation and Nuclear Engineering Technology	A.D. B.S.
	Oscar Rose Junior College Midwest City	Wastewater Technology	A.A.S.
		Environmental Science	A.A.S.
	University of Oklahoma Norman	Environmental Science	B.S. M.S. Ph.D.
OR	Linn-Benton Community College Albany	Wastewater Technology	A.S.
		Water/Wastewater Technology	A.S.
		Water/Wastewater Plant Operator	Cert.
	Oregon Institute of Technology Klamath Falls	Environmental Technology	A.A.S. B.T.
	Oregon State University Corvallis	Nuclear Engineering Technology	B.S.
		Nuclear Engineering	B.S. M.S.

TABLE I

PARTICIPATING INSTITUTIONS

STATE	INSTITUTION	PROGRAM TITLE	DEGREE(S)
	Oregon State University (Cont'd)	Pest Management and Plant Pathology	B.S. M.S.
	Portland State University Portland	Engineering and Applied Science	B.S. M.S.
PA	Carnegie-Mellon University Carnegie Institute of Technology Pittsburgh	Environmental Engineering	B.S. M.S. Ph.D.
	Drexel University Philadelphia	Environmental Engineering and Science	M.S.E.E. M.S.E.S. Ph.D.
	Pennsylvania State University University Park	Acoustics	M.E. M.S. Ph.D.
		Air Pollution Control Technology	A.A.P.C.T.
		Entomology	B.S. M.Agr. M.S. Ph.D.
		Environmental Engineering	B.S. M.S. M.E.E.E. Ph.D.
		Environmental Pollution Control	M.S. M.E.P.C. M.E.
		Environmental Resource Management	B.S.
		Minerals Processing	M.S. Ph.D.
		Mining Technology	A.A.S.

TABLE I

PARTICIPATING INSTITUTIONS

STATE	INSTITUTION	PROGRAM TITLE	DEGREE(S)
	Pennsylvania State University (Cont'd)	Mining Engineering	B.S. M.S. M.E. Ph.D.
		Nuclear Engineering Technology	A.N.E.T.
		Nuclear Engineering	B.S. M.S. M.E. Ph.D.
		Petroleum and Natural Gas Engineering	B.S. M.S. Ph.D.
		Water Resources Engineering Technology	B.T.
	Slippery Rock State College Slippery Rock	Environmental Studies	B.S.
	Temple University Philadelphia	Environmental Technology	A.T.
		Environmental Engineering Technology	B.S.
	University of Pennsylvania Philadelphia	Energy Engineering	M.S.E.
		Energy Management and Policy	M.S.E.M.P. Ph.D.
	University of Pittsburgh Pittsburgh	Environmental and Sanitary Engineering	B.S. M.S. Ph.D.
		Environmental Systems Engineering	degrees granted through Engr. Dept.
	School of Public Health (University of Pittsburgh) Pittsburgh	Acoustic Environmental Control	M.S.(Hyg.) D.S.(Hyg.)
		Air Resources	M.S.(Hyg.)

TABLE I

PARTICIPATING INSTITUTIONS

STATE	INSTITUTION	PROGRAM TITLE	DEGREE(S)
	School of Public Health (University of Pittsburgh) (Cont'd)	Environmental Health Engineering	M.P.H. D.S.(Hyg.)
		Environmental Health Planning	D.S.(Hyg.)
		Health Aspects of Water Quality	M.S.(Hyg.)
		Industrial Hygiene	M.S.(Hyg.)
		Toxicology	D.S.(Hyg.) Ph.D.
		Radiation Health	M.S.(Hyg.) D.S.(Hyg.) Ph.D. D.P.H.
RI	University of Rhode Island Kingston	Environmental Engineering	B.S. M.S. Ph.D.
SC	Clemson University Clemson	Air Pollution	M.S. M.Engr.
		Natural Systems	M.S. M.Engr.
		Planning and Management	M.S. M.Engr.
		Water Treatment Systems	M.S. M.Engr.
		Environmental Systems Engineering	Ph.D.
	Greenville Technical College Greenville	Wastewater Technology	A.A.S.
	Sumter Area Technical College Sumter	Environmental Engineering Technology	A.E.T.
TN	Chattanooga State Technical Community College Chattanooga	Environmental Science Technology	A.S.
		Nuclear Technology	A.S.

TABLE I

PARTICIPATING INSTITUTIONS

STATE	INSTITUTION	PROGRAM TITLE	DEGREE(S)
	East Tennessee State University Johnson City	Environmental Health	B.S.E.H. M.S.E.H.
	Memphis State University Memphis	Audiology	M.A. Ph.D.
	Middle Tennessee State University Murfreesboro	Environmental Science and Technology	B.S.
	State Technical Institute at Memphis Memphis	Environmental Engineering Technology	A.E.
	University of Tennessee Knoxville	Environmental Engineering	M.S.E.E. M.E. Ph.D.
		Environmental Engineering (Air Quality and Pollution Control)	M.S.E.E. M.E. Ph.D.
		Environmental Engineering (Water Pollution Control/ Water Resources)	M.S.E.E. M.E. Ph.D.
		Industrial Audiology	M.A.
		Nuclear Engineering	B.S. M.E. M.S. Ph.D.
		Water Resources Development	M.S.
	Vanderbilt University Nashville	Environmental and Water Resources Engineering (EWRE)	B.E.
		Environmental Science	B.S.
		EWRE (Environmental Science)	M.S. M.Eng. Ph.D.

TABLE I

PARTICIPATING INSTITUTIONS

STATE	INSTITUTION	PROGRAM TITLE	DEGREE(S)
	Vanderbilt University (Cont'd)	EWRE (Air Resources)	M.S. M.Eng. Ph.D.
		EWRE (Solid Waste)	M.S. M.Eng. Ph.D.
		EWRE (Water and Wastewater Treatment/Water Resources)	M.S. M.Eng. Ph.D.
TX	Baylor University Waco	Institute of Environmental Studies	B.A. B.S.
	Lamar University Beaumont	Environmental Science	B.S.
		Energy Resource Management	B.S.
	Rice University Houston	Environmental Science and Engineering	M.S.
	Sam Houston State University Huntsville	Environmental Science	B.S.
	Texas A & M University College Station	Environmental Engineering	M.S. Ph.D.
		Entomology	M.S.
		Entomology/Pest Management Option	M. Ag.
	Texas State Technical Institution Waco	Nuclear Technology	A.A.S.
		Water/Wastewater Technology	A.A.S.
		Water Utility Operator	Certificate
	University of Texas Austin	Environmental Health Engineering	M.S. Ph.D.
		Water Resources Engineering	M.S. Ph.D.

TABLE I

PARTICIPATING INSTITUTIONS

STATE	INSTITUTION	PROGRAM TITLE	DEGREE(S)
UT	Brigham Young University Provo	Chemical Engineering	B.S. M.S.
		Water Resources and Environmental Engineering	B.S. M.S.
	University of Utah Salt Lake City	Civil Engineering	B.S. M.E. M.S. Ph.D.
	Utah State University Logan	Civil and Environmental Engineering	B.S. M.S. Ph.D.
		Pest Management	B.S. M.S.
		Environmental Studies	B.S.
VA	George Washington University NASA-Langley Institute Hampton	Acoustics	M.S. Sc.D.
		Environmental Modeling	M.S.
	J.Sargeant Reynolds Community College Richmond	Environmental Technology Environmental Operations	Cert. A.A.S.
		Ground Water Resources	Cert.
	Virginia Polytechnic Institute and State University Blacksburg	Civil Engineering Technology	B.S.
		Sanitary Engineering/Environmental Sciences and Engineering/Civil Engineering	M.S. Ph.D.
	Wytheville Community College Wytheville	Environmental Technology	Cert.

TABLE I

PARTICIPATING INSTITUTIONS

STATE	INSTITUTION	PROGRAM TITLE	DEGREE(S)
WA	The Evergreen State College Olympia	Coordinated Studies	B.A.
	University of Washington Seattle	Environmental Studies	B.A. B.S.
		Air Resources	M.S. Ph.D.
	Washington State University Pullman	Environmental Science	B.S. M.S.
		Chemical Engineering	M.S.
		Air Pollution Control Engineering	M.S.
		Air Pollution Science	M.S.
		Air Pollution Option	M.S.
		Air Pollution Program	M.S.
	Western Washington University Bellingham	Environmental Studies	B.S.
WV	Bluefield State College Bluefield	Mining Engineering Technology	A.S. B.S.
	West Virginia Institute of Technology Montgomery	Mining Engineering Technology	A.S.E.M.T. B.E.M.T.
	West Virginia University Morgantown	Engineering of Mines	B.S.
		Environmental Engineering	M.S.C.E. M.S.E.
		Mineral Processing Engineering	B.S. M.S.
		Mineral Resource Economics	M.S.
		Petroleum Engineering	B.S. M.S.

TABLE I

PARTICIPATING INSTITUTIONS

STATE	INSTITUTION	PROGRAM TITLE	DEGREE(S)
WI	Marquette University Milwaukee	Environmental Engineering	B.A. B.S.
	Northland College Ashland	Environmental Studies	B.A.
	University of Wisconsin-Green Bay Green Bay	Environmental Emphasis	B.A. B.S. M.E.A.S.
	University of Wisconsin-Madison Madison	Civil and Environmental Engineering	B.S.
		Environmental Communications	M.A. M.S.
		Water Resources Management, Environmental Monitoring, Land Resources	M.S. Ph.D.
	University of Wisconsin-Milwaukee	Atmospheric and Marine Environmental Program	M.S. M.E.
WY	Casper College Casper	Water Quality Technology	A.S.
	University of Wyoming Laramie	Civil Engineering	M.S. Ph.D.

Other Programs

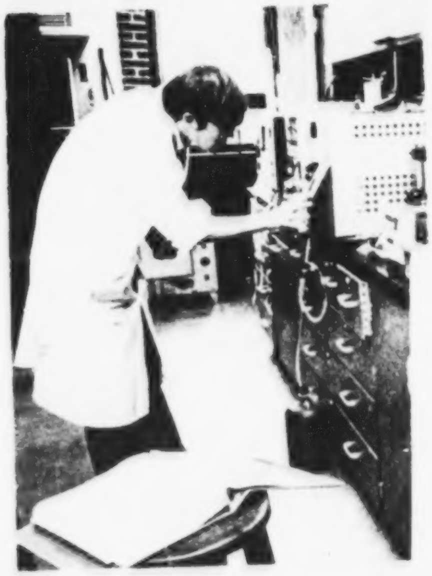
The following programs were included in the on-site visit process and offer training through various institutes, centers, state agencies, or college consortiums. Program descriptions can be found in the volume specified.

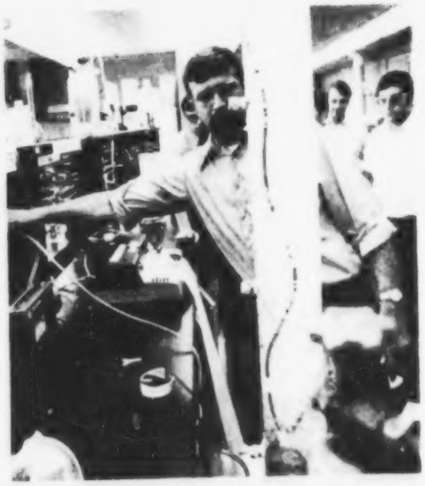
State	Institution	Program	Volume
FL	Florida Department of Environmental Regulation	Environmental Noise Control Training	Noise
	Miami-Dade Community College	NPDES Effluent Monitoring Training	Wastewater I
		Wastewater Treatment Plant Operations	Wastewater I
		Water Treatment Plant Operations	Potable Water I
	University of Miami School of Medicine	Pesticide Protection	Pesticides
KS	Kansas State University	Institute for Environmental Research	Composite II III Business and Industry
MI	Michigan State University	Institute of Water Research	Potable Water I
		Pesticide Research Center	Pesticides
NE	University of Mid-America	Pests, Pesticides and Pesticide Safety	Pesticides

State	Institution	Program	Volume
NJ	Princeton University	Environmental Science and Policy	Composite I
NC	U.S. Environmental Protection Agency	Air Pollution Training Institute	Air
OH	Ohio State University	Center for Lake Erie Area Research	Potable Water I
		Cooperative Extension Service Activities	Composite II and III
		Water Resources Center	Potable Water I
PA	Air Pollution Control Association	Refresher, Continuing Education Courses	Air
	University of Pittsburgh	Environmental Systems Engineering	Composite I
TN	Memphis State University	Nuclear Reactor Fundamentals	Energy
		Radiation Technician Training Course	Radiation
	Oak Ridge Associated Universities	Radiation Emergency Assistance Center/ Training Site	Radiation
		Special Training	Energy Radiation
	University of Tennessee Center For Health Sciences	Training Courses in Audiometric Orientation	Noise

Photo reprinted from the Marquette University Bulletin 1977-78

PROJECT FINDINGS





Photos reprinted from the Michigan Technological University Catalog 1975-76

PROJECT FINDINGS

I. A SUMMARY PROFILE OF REPRESENTATIVE ENVIRONMENTAL ENGINEERING/ HEALTH EDUCATIONAL PROGRAMS

A. States, Institutions, Programs, and Degrees

The Post-Secondary Education Profile (Phase II) Composite: Engineering/ Health includes 93 programs. Originating in 32 states, these programs represent degree offerings from the diploma to the doctoral level. They were selected for inclusion in the survey on the basis of information and recommendations obtained during the workforce assessment phase of this three-year project, from institutional catalogs, and from a review of other published sources of information regarding degree programs in environmental areas. Project personnel gathered detailed information concerning these composite programs through on-site interviews and supplementary correspondence and telephone conversations.

Summary statistics discussed in sections below indicate that programs fall predominately in baccalaureate, masters, and doctoral degree levels and are heavily skewed to the eastern, mid-western, and southern regions. These results do not necessarily indicate that Environmental Engineering and Environmental Health programs do not exist at the sub-baccalaureate level or in western regions. Rather these results caution against making any strict definitive conclusions regionally or across degree levels. The preponderance of degree programs at the bachelors and graduate levels in not surprising given that Environmental Engineering and Environmental Health programs traditionally offer these degrees.

B. Enrollment Statistics and Graduates

Data regarding numbers of full-time and part-time students and the average number of graduates from the Engineering/Health programs surveyed are reported nationally in Table 2.

Part-time enrollment is highest at the master's and doctoral levels which may reflect numbers of students who have completed coursework and are writing theses or dissertations.

Contact personnel report that one-third (33 percent) of the composite programs (or degree offerings, in some cases) surveyed are experiencing upward trends in numbers of graduates annually and an additional 53 percent report stable numbers of diplomas conferred over the last few years. These results suggest a constant to growing production rate of environmental workforce personnel in the Environmental Engineering and Health areas from post-secondary institutions.

Although the survey instrument contained a question concerning enrollment of women, available responses tended to be highly generalized making tabulation and statistical analyses of this item difficult. Comments recorded by interviewers indicate that the percentage of women enrolled in these programs is slowly increasing. This increment may be attributed in part to the excellent job market for females in the environmental area, as perceived by contact personnel.

C. Student Origin

Results regarding student origin (i.e., in-state, out-of-state, foreign) reported in Table 3 reveal some interesting though expected differences across degree levels.

TABLE 2

ENVIRONMENTAL ENGINEERING / HEALTH

NATIONAL ENROLLMENT PROFILE[1]

Degree	Enrollment Full-time	Enrollment Part-time	Graduates Average # Per Year	Enrollment Change by Program[2] Up	Down	Stable
Diploma	14	0	8	0	1	0
Associate	248	65	108	3	4	5
Bachelors	3282	126	858	20	3	14
Masters	1165	604	683	18	7	35
E.E.[3]	4	12	9	0	1	1
Doctoral	238	72	88	9	5	25
TOTAL	4951	879	1754	50	21	80

[1] This profile does not include all institutions offering similar programs in the country. Caution must therefore be taken in drawing any definitive conclusions regarding this profile.

[2] In some cases, figures represent individual degrees.

[3] Environmental Engineering.

TABLE 3

NATIONAL STUDENT-ORIGIN PROFILE

Degree	In-State	Out-of-State	Foreign
Diploma	100%	0%	0%
Associate	97%	3%	1%
Bachelors	85%	14%	2%
Masters	51%	38%	11%
E.E.	N/A	N/A	50%
Doctorate	48%	40%	11%

Students at the diploma, associate, and bachelors levels are predominately in-state (100, 97, and 85 percent respectively), while graduate enrollment is divided almost equally between in-state and out-of-state or foreign students. The reasons for these percentages are not absolute but may reflect several conditions. One, graduate programs--especially those offering excellent research facilities, in-state tuition rates, and assistantships or fellowships--can attract quality, out-of-state students who are competitive with any candidates maintaining residence in home states. Tuition remission and comparable financial aid offers are not widespread at the undergraduate level. Two, associate and baccalaureate degree students may be most attracted to or most familiar with institutions within a reasonable proximity to their homes, especially if full-time employment is a mitigating factor in program choice. Third, some institutions specify the ratio of in-state to out-of-state students.

D. Employment and Environmental Occupations

The job placement of graduates trained in Environmental Engineering, Health, and related areas plays a critical role in meeting environmental workforce needs. Though graduate follow-up characterizes approximately three out of every five programs (or degrees, in some cases), surveys of former students vary in specificity and completeness among institutions. Therefore, data concerning employment of graduates--particularly beyond initial placement--are less than exact. As part of this Phase II survey, contact personnel were asked what percentage of their program graduates are employed in industry, consulting, government, or other fields (teaching positions, etc.). Employment results by degree level are reported in Table 4.

Nationally, industry and government appear to draw greater numbers of Environmental Engineering and Environmental Health graduates than consulting firms and educational institutions. Though statistical analyses were not performed, variance across degree levels does not appear significant.

Government, as defined in this survey, encompasses the broad public sector (municipal, state, regional, and federal levels). In large measure, environmental regulation, monitoring, enforcement, and overall protection activities fall under the auspices of this sector. Past legislative mandates to the private sector have precipitated employment opportunities in the public sector to insure implementation. Likewise, the public sector has been forced to employ environmentally-trained personnel in order to comply with public sector legislation. Thus, both government and industry need personnel.

TABLE 4

ENVIRONMENTAL ENGINEERING / HEALTH

NATIONAL EMPLOYMENT PROFILE[1]

Degree	Private Sector[2] Industry	Private Sector[2] Consulting	Total	Government	Other
Diploma	1%	0%	1%	99%	0%
Associate	32%	14%	46%	53%	0%
Bachelors	36%	17%	53%	38%	10%
Masters	29%	25%	54%	39%	7%
E.E.[3]	58%	11%	69%	27%	3%
Doctoral	28%	30%	58%	32%	10%
TOTAL	32%	20%	52%	39%	8%

[1] This profile does not include all institutions offering similar programs in the country. Caution must therefore be taken in drawing any definitive conclusions regarding this profile.

[2] If contact persons did not distinguish between industry and consulting in their responses, the private sector percentage given was evenly divided between industry and consulting.

[3] Environmental Engineering

The salaries that some educational institutions can afford to pay do not compare favorably with those in government or the private sector, nor are job openings as numerous. Both considerations may help explain the low percentage of graduates entering teaching positions.

The training represented by these environmental engineering, health, and related programs essentially prepares students for work in industry, government, and consulting, and not teaching, except at the doctoral level. That is to say, training and job placement correlate highly. Though the design of this project does not permit ascertainment of longitudinal shifts in employment, such a study would be potentially very useful in projecting necessary modification in training.

In an attempt to identify more specifically those occupations which Environmental Engineering/Health graduates would be qualified to fill, survey participants were asked to check on a prepared form those jobs that graduates of a given degree program would be trained to assume. Occupational titles so identified by a majority of contact personnel responding are listed below according to degree level:

Certificate

Air Pollution Control Technician
Air Pollution Control Technician (trainee)
Environmental Monitoring Specialist
Environmental Specialist/Solid Waste Management
Regulatory Specialist
Sanitary Technician
Solid Waste Collection Operator
Vector Control Specialist

Associate

Air Pollution Control Technician
Environmental Control Technologist
Environmental Engineering Technician
Environmental Health Aide/Technician
Environmental Monitor Specialist
Environmental Tester/Analyst
Pollution Control Specialist
Sanitary Technician
Wastewater Treatment Plant Operator
Water/Wastewater Equipment Technician
Water/Wastewater Treatment Operator

Bachelors

Environmental Engineer
Environmental Engineer - Water Pollution Control
Environmental Engineer - Water Resources
Industrial Waste Inspector
Public Health Sanitarian/Inspector/Engineer
Sanitarian
Water/Wastewater Treatment Operator
Wastewater Treatment Plant Operator

Masters

Environmental Engineer
Environmental Engineer - Water Pollution Control
Environmental Engineer - Water Resources
Environmental Specialist/Solid Waste Management
Pollution Control Specialist
Sanitary Engineer

Environmental Engineering

Air Pollution Analyst
Air Pollution Control Engineer
Environmental Control Technologist
Environmental Engineer
Environmental Engineer - Water Pollution Control
Environmental Engineer - Water Resources

Doctoral

Environmental Engineer
Environmental Engineer - Water Pollution Control

E. Graduate Follow-Up

As indicated earlier, approximately 60 percent of the Environmental Engineering, Health, and related technology programs surveyed engage in some form of graduate follow-up with varying degrees of success. Common methods used are newsletters, questionnaires, personal contact, conventions and professional gatherings, and alumni association records. No responses to this survey item appear unique to a single institution. The important task of tracing graduates, not only to maintain job histories but to obtain curriculum feedback, demands that both program administrators and program graduates share the responsibility.

F. Faculty

Of the 93 Environmental Engineering, Health, and related programs surveyed in Phase II, full-time faculty total 823 and part-time faculty total 383. These figures are based essentially on intra-program definitions of full- or part-time staff assignments. For example, some programs define part-time personnel as faculty who may teach only one course and whose primary responsibilities rest in another department. This factor alone makes any generalization difficult. There do not appear to be any consistent differences across degree levels.

G. Internship/Applied Study Term

Of the 157 separate degree programs offering information, 46 provide for some form of internship or applied study term as part of their student training. These options offer students supervised, on-the-job experience related to their classroom and laboratory instruction. Internship or applied study terms prepare students for real-world situations encountered in subsequent employment and may facilitate job placement. For some students, salaries paid to them for their work under these application oriented instructional programs are a means of financial aid. Environmentally related internship programs place students in industry, consulting, government, and business.

II. ADDITIONAL FINDINGS

A. Recruitment Techniques

While some programs claim that their reputation alone attracts quality applicants, most utilize some formal means of recruitment. Posters, brochures, visitations to local high schools, and campus career days number among the most popular. Graduate programs often attract students from the same institution's undergraduate student body; and university offices (admission, public relations) supervise and supplement program recruitment efforts on many campuses. Those programs with extensive research facilities, traineeships, or other curricular or financial attractions find such inducements facilitate recruitment. Former graduates often steer potential students to programs. One institution even televises the "success stories" of its graduates. The success of any one recruitment method is difficult to project across programs and is in reality undoubtedly the function of many intervening variables.

B. Sources of Student Support

Student financial aid packages also help in the recruitment process. For those programs included in this Environmental Engineering/Health volume, undergraduates typically are supported by scholarships; federal, state, and campus loan programs; college work study; and part-time employment outside the university. The majority of graduate students enrolled in many of these programs are employed by their departments as teaching or research assistants or as support personnel on program grants or contracts. At the graduate level, support funding and/or tuition remission or reduction are often critical variables in enrollment. Traineeships from federal agencies such as the Environmental Protection Agency and the National Institute of Occupational Safety and Health to support students are considered too few in number.

C. Research Funding

The financial stability of environmental programs is often a key to their success or demise. Monies for research enable programs to attract faculty and students. Research funding--most typically in the form of grants, contracts, or consulting work--accounts for minimal to substantial percentages of faculty salaries. Those institutions with more support personnel and services (e.g., graduate students, clerical help, grant writing officers, or research centers) and those able to offer faculty release time for research, not surprisingly tend to be those schools where research funds are more abundant.

Sources of research funding vary widely across programs. More frequently cited ones include:

1) Department of Energy
2) Department of Interior
3) Department of Health, Education, and Welfare
4) Housing and Urban Development Administration
5) National Aeronautics and Space Administration
6) National Geological Survey
7) National Institute of Health
8) National Institute of Occupational Safety and Health
9) National Science Foundation
10) Occupational Safety and Health Administration
11) Office of Water Research Technology
12) Rockefeller Foundation
13) Sea Grant
14) U.S. Air Force, Army, and Navy
15) U.S. Environmental Protection Agency
16) U.S. Public Health Service

State agencies, private corporations, regional study commissions, and other entities also provide important research funding.

More important perhaps than the question of what agency is giving that most in environmental research funds and student stipends to the educational community is the issue of how critical the continuation and escalation of such financial support is for the maintenance and growth of existing programs. Curriculum changes, additional faculty lines, laboratory costs, and salary increments cost money. Environmental programs are looking more and more to the federal government for financial support. A substantial number indicate that without that support, their programs are in danger of decline and even collapse. (For more detailed information regarding sources of research funding and research activities, see individual program summaries.)

D. Usage of ERIC and IRIS

Computerized information retrieval systems now available to the educational community greatly speed initial reviews of literature and provide inexpensive access to a wide variety of materials. ERIC and IRIS are two such retrieval systems that include environmentally related materials. The inherent effectiveness of ERIC and IRIS depends in part of their utilization with the educational community. Of the 51 Environmental Engineering/Health programs responding to a survey question on usage of these systems, only seven contact persons (13 percent) indicated that they use ERIC and only six persons (12 percent) indicate that they use IRIS. Engineering Health program responses and responses from all institutions participating in this Phase II survey concerning use of ERIC and IRIS are reported in Tables 5 and 6. The results of the composite section parallel those at the national level.

TABLE 5

ERIC/IRIS UTILIZATION PROFILE - ENGINEERING/HEALTH

	Yes	No	Total Responding
ERIC	7	43	51
IRIS	6	44	51

TABLE 6

ERIC/IRIS UTILIZATION PROFILE - NATIONAL SUMMARY

	Yes	No	Total Responding
ERIC	72	307	379
IRIS	64	314	378

Faculty members responding to this ERIC/IRIS survey item were not asked the reasons for their answers, but a sizable percentage indicated that they were not even aware of these particular information retrieval systems. The fact that IRIS primarily contains water and wastewater materials may help explain the unfamiliarity of environmental engineering and health faculty with this system if their expertise and teaching responsibilities are not in these two areas. However, these results must prompt questions of how widely disseminated and how widely publicized ERIC and IRIS services are within the environmental training community. Other retrieval systems mentioned by faculty members include CRIS (Cooperative Research Information Service), NTIS (National Technical Information Service), Oak Ridge Nuclear Information Center, TOXLINE, and a Water Research Institute system as well as individual library computer systems for information retrieval.

E. Program Flexibility

Changing employment needs and new technology necessitate curriculum modifications in the educational training of our environmental workforce. The time constraints under which schools can implement new courses or new programs (e.g., series of courses, degree offerings) give some indication of the flexibility of the Environmental Engineering, Health, and related programs surveyed in Phase II. Tables 7 and 8 summarize the responses to questions asking the time needed to implement new courses and new programs.

The number of responses in the one-month to one-year category indicates that course and program changes can usually be implemented within an academic calendar year. Differences across degree levels do not appear significant. Program modifications appear to take more time than course implementation which is not surprising given the greater scope of a program relative to a single course. Responses to these questions were often conditional; participants indicated that implementation schedules depend in large measure on the availability of faculty time and financial resources, departmental and institutional support, and the preparation readiness of course syllabi and materials. The responses noted in these tables may indeed only represent the minimum time needed to process course and program requests through the institutional structure if there are no intervening complications.

F. Communication and Financial Management Skills

A concern of professionals in the environmental workforce is that graduates often are weak in the communication skills needed to inform the

TABLE 7

TIME REQUIRED TO IMPLEMENT A COMPLETE CONTENT CHANGE IN A COURSE

Degree Program	Less than 1 month	1 month-1 year	more than 1 year; less than 2	2-4 years	more than 4 years	Undetermined
Associate	3	7	0	0		3
Bachelors	5	26	1	1		6
Masters	7	40	1	0		9
Doctoral	4	30	1	0		6
TOTAL	19	103	3	1		24

TABLE 8

TIME REQUIRED TO IMPLEMENT A COMPLETE PROGRAM SEQUENCE

Degree Program	Less than 1 month	1 month-1 year	more than 1 year; less than 2	2-4 years	more than 4 years	Undetermined
Associate	0	5	2	3		3
Bachelors	0	16	2	9		12
Masters	3	29	3	8		14
Doctoral	1	21	1	6		11
TOTAL	4	71	8	26		40

public and private sectors regarding pollution and its control and abatement and the persuasive expertise to stimulate constructive social action based on that information. Survey participants were asked their reactions to this concern. Those contact persons representing Environmental Engineering, Health, and related technologies generally agree that adequate communication skills of environmentally trained persons are of major concern. The curricular response designed to sharpen students capabilities in this important area varies from one institution to another and across degree levels. Many undergraduate engineering programs require that students take a technical writing course, while graduate students in all areas typically must write an acceptable thesis or dissertation and are encouraged to publish their work. Students at all levels are usually called upon to present oral reports in classes and seminars. A common consensus among environmental educators is that post-secondary students in all disciplines--not just Environmental Engineering and Health--lack adequate communication-skills preparation. The solution of this problem rests with the entire educational community and is not easily achieved.

Similar concerns regarding financial management skills of environmental graduates elicited slightly different responses. Some survey participants maintain that associate- and bachelors-level graduates do not necessarily need an in-depth knowledge of economics because they typically take sub-managerial jobs which do not require financial decision-making. Engineering course work at some point usually emphasizes the cost benefits and economic considerations of proposed designs. Nevertheless, educators agree that environmental policy and decision-making must reflect sound short- and long-term economic projections.

III

A Summary Profile of Representative Educational Programs

The following footnotes (1-6) refer to the various column headings of the Table. Other footnotes are specific to the figures which were provided by various institutions and are used throughout the Table.

[1] Enrollment - 1976-77 statistics

[2] Graduates - average for last three years; 'change' indicated apparent trends within that three-year period

[3] Employment - 'other' includes positions such as those found within the educational community

[4] Faculty - full-time and part-time is determined by individual institutions

[5] Internship/Applied Study - part of an option to obtain a degree; may or may not have financial reimbursement connected with it

[6] Graduate Follow-up - a standardized procedure that enables the institution to periodically determine the employment of their graduates

[7] enrollment figures are estimated

[8] Juniors and Seniors only

[9] students specializing in environmental areas

[10] no longer functional

NA - Not Available/Not Applicable

*Asterisk - denotes that a program appears in more than one volume of the profile

TABLE

A SUMMARY PROFILE OF REPRESENTATIVE

				ENROLLMENT[1]		GRADUATES[2]	
STATE	INSTITUTION	PROGRAM	DEGREE	FULL TIME	PART TIME	No. / YEAR	CHANGE
AL	University of Alabama	Environmental Engineering	M.S. (3)	16	0	4	Up
AK	University of Alaska	Environmental Quality Engineering	M.S.	3	9	3	Down
AR	University of Arkansas	Agricultural Engineering	B.S.	57	0	5	Up
			M.S.	3	0	2	Stable
			Ph.D.	2	0	0	Up
		Environmental Science/Engineering/Civil Engineering	B.S.	25	0	15	Stable
			M.S. (En.E.)	5	30	8	Stable
			M.S. (C.E.)	1	0	N/A	Down
CA	California Polytechnic State University	Environmental Engineering	B.S.	161	0	25	Stable
	California Institute of Technology	Environmental Engineering Science	M.S.	7	0	8	Stable
			Ph.D.	20	0	5	Stable
CT	Yale University	* Environmental Health	M.P.H.	20	0	10	Stable

9

ENGINEERING/HEALTH PROGRAMS

STUDENT ORIGIN IN-STATE/ OUT-OF-STATE/ FOREIGN (%)	EMPLOYMENT				FACULTY[4]		INTERNSHIP/[5] APPLIED STUDY		GRADUATE[6] FOLLOW-UP	
	PRIVATE SECTOR									
	INDUSTRY	CONSULTING	GOV'T	OTHER[3]	FULL TIME	PART TIME	YES	NO	YES	NO
85/15/0	15%	60%	20%	5%	8	3		X	X	
83/17/0	50%		50%		2	0		X		X
94/0/6	40%	10%	50%		11	0		X		X
33/0/67	40%	10%	50%					X		X
50/0/50		N/A						X		X
95/5/0	33%	33%	33%		5	0		X	X	
90/10/0	33%	33%	33%					X	X	
90/10/0	33%	33%	33%				X		X	
99/1/0	70%		30%		6	0	X		X	
20/80/0	30%	50%	20%		18	0		X	X	
20/80/0	15%	50%	10%	25%				X	X	
25/50/25	50%		50%		10	0	X		X	

TABLE

A SUMMARY PROFILE OF REPRESENTATIVE

STATE	INSTITUTION	PROGRAM	DEGREE	ENROLLMENT[1] FULL TIME	PART TIME	GRADUATES[2] No. / YEAR	CHANGE
DE	Delaware Technical and Community College	*Environmental Engineering Technology	A.A.S.	20	20	10	Stable
	University of Delaware	Environmental Engineering	M.A.S. M.E.	14	14	6	Stable
			Ph.D.	1	0	1	
DC	Catholic University	Civil Engineering	B.S.	72	0	15-20	Up
	Howard University	Environmental Engineering	M.E.	20	4	10	Up
FL	Florida International University	Environmental Engineering Technology	B.S.	13[7]	52[7]	12	Stable
	Heed University	Ocean and Environment Affairs	M.A.	0	0	0	Stable
			Ph.D.	0	3	2	Stable
GA	Georgia Institute of Technology	Environmental Studies	Adv. Cert.	N/A	N/A	5	Varies
	University of Georgia	Environmental Health Science	B.S.E.H.	75	0	26	Up
IN	Purdue University	*Environmental Sciences Options	B.S.	15	0	4	Stable

9

ENGINEERING/HEALTH PROGRAMS

STUDENT ORIGIN IN-STATE/ OUT-OF-STATE/ FOREIGN (%)	EMPLOYMENT				FACULTY[4]		INTERNSHIP/ APPLIED STUDY[5]		GRADUATE[6] FOLLOW-UP	
	PRIVATE SECTOR INDUSTRY	PRIVATE SECTOR CONSULTING	GOV'T	OTHER[3]	FULL TIME	PART TIME	YES	NO	YES	NO
99/1/0	99%		1%		2	2		X		X
33/33/33 33/33/33	30%	40%	30%		4	0		X	X	
50/50/0	30%		30%	40%	7	2	X			X
10/45/45		45%	45%	10%	4	1		X		X
80/20/NA	30%		70%		5	5		X		X
10/90/0	N/A	N/A	N/A	N/A	17	0		X	N/A	
N/A	N/A	N/A	N/A	N/A	0	13		X		X
88/12/NA	50%		30%	20%	1	0		X	X	
67/33/0	25%		50%	25%	280	0		X		X

TABLE

A SUMMARY PROFILE OF REPRESENTATIVE

STATE	INSTITUTION	PROGRAM	DEGREE	ENROLLMENT[1] FULL TIME	ENROLLMENT[1] PART TIME	GRADUATES[2] No. / YEAR	GRADUATES[2] CHANGE
IA	Kirkwood Community College	Environmental Health Assistant	Dipl.	14	0	8	Down
		Environmental Health Technician	A.A.	5	0	5	Down
KS	Kansas State University	Chemical Engineering	B.S.	180	0	35	N/A
			M.S.	12	0	4	Stable
			Ph.D.	10	0	2	Stable
		Mechanical Engineering	B.S.	276	0	50	Stable
			M.S.	13	4	10	Stable
			Ph.D.	7	4	2	Stable
	University of Kansas	Environmental Health Engineering/ Science	M.S.	15	15	10	Stable
			Ph.D.	7	3	1-2	Stable
KY	University of Louisville	Environmental Engineering	B.S.[8]	26	0	13	Up
			M.E.	14	0	6	Up
	Western Kentucky University	Environmental Engineering Technology	B.S.	40	0	8	Up
		Environmental Science	B.S.	37	0	7	Up

9

ENGINEERING/HEALTH PROGRAMS

STUDENT ORIGIN IN-STATE/ OUT-OF-STATE/ FOREIGN (%)	EMPLOYMENT PRIVATE SECTOR INDUSTRY	CONSULTING	GOV'T	OTHER[3]	FACULTY[4] FULL TIME	PART TIME	INTERNSHIP/[5] APPLIED STUDY YES	NO	GRADUATE[6] FOLLOW-UP YES	NO
100/0/0	1%		99%		1	1	X		X	
100/0/0	1%		99%		1	1	X		X	
N/A	70%		10%	20%	11	0		X	X	
N/A	70%		10%	20%				X	X	
N/A	60%	10%	10%	20%				X	X	
N/A		N/A			16	1	X			X
N/A		N/A					X			X
N/A		N/A					X			X
20/74/6	5%	55%	40%		4	1		X	X	
20/74/6	5%	55%	40%					X	X	
92/8/NA	40%		55%	5%	9	0	X		X	
78/22/NA	17%	21%	43%	19%	2	7		X	X	
80/20/NA	17%	21%	37%	25%	2	7		X	X	

TABLE

A SUMMARY PROFILE OF REPRESENTATIVE

STATE	INSTITUTION	PROGRAM	DEGREE	ENROLLMENT[1] FULL TIME	ENROLLMENT[1] PART TIME	GRADUATES[2] No. / YEAR	GRADUATES[2] CHANGE
LA	Delgado College	Environmental Health	A.S.	41	0	6	Stable
	McNeese State University	Environmental Science	B.S.	23	4	10	Stable
			M.S.	24	0	7	Stable
ME	University of Maine	*Sanitary Engineering	M.S.	14	0	5	Up
			Ph.D.	3	0	1	Up
MD	John Hopkins University	Environmental Engineering	M.S. M.S.E. M.S. (Systems) Ph.D.	43	7	6-8	Up
MA	Massachusetts Institute of Technology	Environmental Engineering	Env.Eng.	3	0	2	Stable
	Springfield Technical Community College	*Environmental Technology	A.A.S.	26	0	10	Up
MI	Ferris State College	Environmental Health Technician	A.A.S.	29	0	17	Down
			B.S.	82	0	29	Up

9

ENGINEERING/HEALTH PROGRAMS

STUDENT ORIGIN IN-STATE/ OUT-OF-STATE/ FOREIGN (%)	EMPLOYMENT				FACULTY[4]		INTERNSHIP/[5] APPLIED STUDY		GRADUATE[6] FOLLOW-UP	
	PRIVATE SECTOR									
	INDUSTRY	CONSULTING	GOV'T	OTHER[3]	FULL TIME	PART TIME	YES	NO	YES	NO
95/5/NA	50%		50%		3	10		X		X
95/5/NA	95%		5%		5	2		X	X	
80/15/5	60%		40%					X	X	
N/A	25%	50%	25%		5	0		X	X	
N/A	25%	50%	25%					X	X	
12/88/0		10%	40%	50%	11	1	X			X
12/88/0		10%	40%	50%			X			X
12/88/0		10%	40%	50%			X			X
12/88/0		10%	40%	50%			X			X
N/A		50%	35%	15%	N/A	N/A	X			X
90/10/0	20%		80%		2	0	X		X	
99/1/0	40%	0	60%	0	6	2		X		X
99/1/0	40%	0	60%	0				X		X

TABLE

A SUMMARY PROFILE OF REPRESENTATIVE

STATE	INSTITUTION	PROGRAM	DEGREE	ENROLLMENT[1] FULL TIME	PART TIME	GRADUATES[2] No. / YEAR	CHANGE
MI	Michigan State University	Environmental Engineering	B.S.[9]	55	5	30	Stable
			M.S.	6	4	8	Stable
			Ph.D.	1	1	.25	Stable
	University of Michigan	Environmental Science Engineering	B.S.E.	79	0	10-12	N/A
		*Industrial Hygiene	M.S.	11	0	9	Up
			M.P.H.	24	0	8	Stable
			D.P.H.	0	0	0	Stable
			Ph.D.	10	0	2	Stable
MN	University of Minnesota	Environmental Health	M.P.H. M.S. Ph.D.	50	30	40	Stable
NJ	Middlesex	*Environmental Health Science Technology	A.A.S.	15	4	15	Stable
	New Jersey Institute of Technology	Interdisciplinary Studies in Environmental Engineering	M.S.	N/A	N/A	N/A	N/A
	Rutgers-State University of New Jersey	*Environmental Science	M.S. Ph.D.	70	60	40	Up
	Stevens Institute of Technology	Environmental Engineering/ Environmental Science	M.S.	0	0	N/A	N/A

9

ENGINEERING/HEALTH PROGRAMS

STUDENT ORIGIN IN-STATE/ OUT-OF-STATE/ FOREIGN (%)	EMPLOYMENT PRIVATE SECTOR INDUSTRY	CONSULTING	GOV'T	OTHER[3]	FACULTY[4] FULL TIME	PART TIME	INTERNSHIP/[5] APPLIED STUDY YES	NO	GRADUATE[6] FOLLOW-UP YES	NO
90/9/1	2%	80%	18%		3	0	X		X	
90/9/1	2%	80%	18%					X	X	
90/9/1	2%	80%	18%					X	X	
N/A	30%	20%	50%		0	0		X	X	
64/36/0	90%		10%		3	0	X		X	
54/42/4	90%		10%				X		X	
N/A		N/A					X		X	
50/40/10	90%		10%				X		X	
40/55/5	15%	5%	75%	5%	8	10		X		X
100/0/0	83%		17%		4	0	X		X	
96/4/0		N/A			10	0	X			X
75/25/0	35%		50%	15%	12	2	X			X
	35%		50%	15%				X		X
N/A		N/A			6	2		X		X

TABLE

A SUMMARY PROFILE OF REPRESENTATIVE

STATE	INSTITUTION	PROGRAM	DEGREE	ENROLLMENT[1] FULL TIME	ENROLLMENT[1] PART TIME	GRADUATES[2] No. / YEAR	GRADUATES[2] CHANGE
NJ	Stevens Institute of Technology	Environmental Engineering/ Environmental Science	M.E.	1	0	N/A	N/A
			Ph.D.	0	0	N/A	N/A
NY	Clarkson College	Civil and Environmental Engineering	B.S.	530	0	120	Up
			M.S.	20	5	12	Up
	Cornell University	*Environmental Engineering	B.S.	15	0	15	Down
			M.S. M.Eng. Ph.D.	18	0	15	Down
		Waste Management Engineering	M.S.	8	0	6	Stable
			M.Eng.				Stable
			M.P.S.				Stable
			Ph.D.				Stable
	Hunter College	Environmental Health Science	B.S.	34	0	10	Up
			M.S.	20	32	12	Stable
	Polytechnic Institute of New York	Environmental Engineering and Planning	M.E.H.S. M.S.C.E.	2	15	5	Stable
			Engr. Ph.D.	12	115	72	Down

9

ENGINEERING/HEALTH PROGRAMS

STUDENT ORIGIN IN-STATE/ OUT-OF-STATE/ FOREIGN (%)	EMPLOYMENT				FACULTY[4]		INTERNSHIP/[5] APPLIED STUDY		GRADUATE[6] FOLLOW-UP	
	PRIVATE SECTOR INDUSTRY	PRIVATE SECTOR CONSULTING	GOV'T	OTHER[3]	FULL TIME	PART TIME	YES	NO	YES	NO
0/0/100		N/A			6	2		X		X
N/A		N/A						X		X
90/10/0	60%		40%		21	1		X	X	
90/10/0	60%		40%					X	X	
N/A	80%		20%		5	0	X			X
N/A								X		X
N/A	15%	75%	10%					X		X
N/A								X		X
N/A	25%	50%	25%		4	6		X		X
N/A	25%	50%	25%					X		X
N/A	25%	50%	25%					X		X
N/A		25%	25%	50%				X		X
N/A	20%		30%	50%	3	4	X		X	
N/A	3%	13%	38%	46%			X		X	
NA/NA/50	75%		25%		12	0		X		X
NA/NA/50	75%		25%					X		X
NA/NA/50	75%		25%					X		X
NA/NA/50	75%		25%					X		X

TABLE

A SUMMARY PROFILE OF REPRESENTATIVE

STATE	INSTITUTION	PROGRAM	DEGREE	ENROLLMENT[1] FULL TIME	ENROLLMENT[1] PART TIME	GRADUATES[2] No. / YEAR	GRADUATES[2] CHANGE
NY	Rensselaer Polytechnic Institute	* Environmental Engineering	B.S.	20	0	25	
			M.E. M.S. Eng.D. Ph.D.	40	14	20 3	N/A
	Syracuse University	Environmental Engineering	B.S.	44	0	12	Stable
	The Cooper Union	Integrated Master's Program in Engineering	M.E.	25	0	N/A	N/A
NC	Duke University	Civil Engineering/ Urban and Environmental Engineering	M.S.	26	0	8	Stable
			Ph.D.		0	4	Stable
	North Carolina State University	Environmental Engineering	M.C.E.	22[6]	0	8[7]	Down
			M.S.		0		
			Ph.D.		0	3	
	University of North Carolina	Environmental Management and Protection	M.S.	21[7]	N/A	0	Stable
			M.S.P.H.			10	
			M.P.H.			.5	
			Ph.D.	1	N/A	0	Stable

9

ENGINEERING/HEALTH PROGRAMS

STUDENT ORIGIN IN-STATE/ OUT-OF-STATE/ FOREIGN (%)	EMPLOYMENT PRIVATE SECTOR INDUSTRY	CONSULTING	GOV'T	OTHER[3]	FACULTY[4] FULL TIME	PART TIME	INTERNSHIP/[5] APPLIED STUDY YES	NO	GRADUATE[6] FOLLOW-UP YES	NO
20/80/0	20%	60%	20%		4.5	5.5	X		X	
20/80/0	20%	60%	20%					X	X	
60/40/0	25%	50%	25%		0	12		X		X
85/15/0	75%		25%		0	20	X			X
10/90/NA		66%	33%		11	4		X		X
		66%		33%						
60/40/NA	7%	38%	38%	17%	0	8		X	X	
48/52/0		23%	46%	31%	3	1		X	X	

TABLE

A SUMMARY PROFILE OF REPRESENTATIVE

				ENROLLMENT[1]		GRADUATES[2]	
STATE	INSTITUTION	PROGRAM	DEGREE	FULL TIME	PART TIME	No. / YEAR	CHANGE
OH	Hocking Technical College	Environmental Health Technology	A.A.S.	53	1	15	Up
	Muskingum Area Technical College	*Environmental Quality Control Technology	A.A.S.	26	4	8	Up
	Ohio State University	Agricultural Engineering	B.S.	80	0	18-20	Stable
			M.S.	8	0	3	Stable
			Ph.D.	14	0	4	Stable
		*Civil Engineering	B.S.[9]	35	3	32	Up
			M.S.[9]	16	5	6-8	Up
			M.S./ P.A.	0	2	1	Stable
			Ph.D.[9]	4	1	1	Up
		Environmental Biology	M.S.	6	1	5	Stable
			Ph.D.	6	1	2	Stable
	Ohio University	Environmental Studies	M.S.	8	2	5-10	Stable
	Raymond Walters General & Technical College (University of Cincinnati)	Environmental Control/ Protection Technology	A.S.	17	8	12-15	Stable
	University of Cincinnati	Civil and Environmental Engineering	M.S.	20	50	20-25	Stable
			Ph.D.	2	5	1-2	Stable

9

ENGINEERING/HEALTH PROGRAMS

STUDENT ORIGIN IN-STATE/ OUT-OF-STATE/ FOREIGN (%)	EMPLOYMENT				FACULTY[4]		INTERNSHIP/[5] APPLIED STUDY		GRADUATE[6] FOLLOW-UP	
	PRIVATE SECTOR INDUSTRY	CONSULTING	GOV'T	OTHER[3]	FULL TIME	PART TIME	YES	NO	YES	NO
100/0/0	1%		99%		2	1	X		X	
99/1/0	50%	20%	20%	10%	2	0	X		X	
95/5/0	N/A	N/A	N/A	N/A	12	0		X	X	
80/20/0								X	X	
80/20/0								X	X	
80/17/3	20%	25%	40%	15%	7	0		X	X	
75/0/25	20%	30%	40%	10%				X	X	
100/0/0		40%	60%				X		X	
34/0/66	20%	20%	20%	40%				X	X	
80/20/0		80%	20%		0	18-20		X	X	
80/20/0		80%	20%					X	X	
60/40/0			50%	50%				X	X	
100/0/0	16%	16%	66%		4	3	X		X	
30/45/25	16%	16%	48%	20%	7	2	X		X	
30/45/25	16%	16%	48%	20%			X		X	

TABLE

A SUMMARY PROFILE OF REPRESENTATIVE

STATE	INSTITUTION	PROGRAM	DEGREE	ENROLLMENT[1]		GRADUATES[2]	
				FULL TIME	PART TIME	No. / YEAR	CHANGE
OH	University of Cincinnati	Environmental Health	M.S.	3	0	4	Down
			Ph.D.	13	0	1	Up
		*Industrial Hygiene	M.S.	23	22	12	Up
			Ph.D.	8	0	2	Up
		Occupational Medicine	M.S.	11	1	5	Stable
			Ph.D.	0	0	0	Stable
	University of Toledo	Environmental Engineering/ Engineering Science	B.S.Ch.E.	1	0	N/A	Stable
			B.S.C.E.	18	0	N/A	Stable
			M.S.Ch.E.	2	3	2	Stable
			M.S.C.E.	1	7	2	Stable
			M.S.Eng.S.	2	11	2	Up
OK	East Central Oklahoma State University	Environmental Science	B.S.	57	7	18	Up
	Oscar Rose Junior College	Environmental Science	A.A.S.	8	8	3	Stable
	OSU Oklahoma City Technical Institute	Environmental Health	A.S.	0	20	3	Down
	University of Oklahoma	Environmental Science	B.S.	40	0	10	Stable
			M.S.	42	93	30	Up
			Ph.D.	9	26	5	Up

9

ENGINEERING/HEALTH PROGRAMS

STUDENT ORIGIN IN-STATE/ OUT-OF-STATE/ FOREIGN (%)	EMPLOYMENT				FACULTY[4]		INTERNSHIP/[5] APPLIED STUDY		GRADUATE[6] FOLLOW-UP	
	PRIVATE SECTOR									
	INDUSTRY	CONSULTING	GOV'T	OTHER[3]	FULL TIME	PART TIME	YES	NO	YES	NO
33/33/33	22%		57%	21%	11	0		X	X	
54/46/0	22%		31%	46%				X	X	
35/65/0	60%		40%		10	0		X	X	
20/30/50	20%		80%					X	X	
17/58/25	38%	5%	37%	20%	4	20	X		X	
N/A		N/A					X		X	
90/10/0	50%			50%	6	0	Variable		X	
70/20/10	30%	20%	40%	10%						
75/22/3	70%	20%	10%							
85/10/5	45%	15%	35%	5%						
70/10/20	50%	5%	45%							
70/30/NA	30%		70%		3	0		X	X	
92/NA/7	65%		35%		3	6	X		X	
100/NA/NA	60%		40%		2	1		X	X	
90/NA/10	10%	15%	75%		9	0		X	X	
68/7/25	30%	30%	40%					X	X	
70/10/20	30%	35%	25%	10%				X	X	

TABLE

A SUMMARY PROFILE OF REPRESENTATIVE

STATE	INSTITUTION	PROGRAM	DEGREE	ENROLLMENT[1] FULL TIME	ENROLLMENT[1] PART TIME	GRADUATES[2] No. / YEAR	GRADUATES[2] CHANGE
PA	Carnegie Institute of Technology	* Environmental Engineering	B.S.	N/A	N/A	34	Up
			M.S. M.E.	20	0	19	Up
			Ph.D.	8	0	2	Stable
	Drexel University	* Environmental Engineering and Science	M.S. M.E. Ph.D.	69	36	15	Up
						12	N/A
						4	Stable
	Slippery Rock State College	Environmental Studies	B.S.	45	0	9	Up
	Temple University	* Environmental Technology/ Environmental Engineering Technology	A.T.	8	0	2	Down
			B.S.	64	12	15	Up
	The Pennsylvania State University	* Environmental Engineering	B.S.	127	3	23	Up
			M.S. M.E. Ph.D.	19	0	8	Up
		* Environmental Pollution Control	M.S. M.E.P.C. M.E.	25	1	14	Stable
	University of Pittsburgh	* Environmental/ Sanitary Engineering	B.S.	35	0	12	Up

9

ENGINEERING/HEALTH PROGRAMS

STUDENT ORIGIN IN-STATE/ OUT-OF-STATE/ FOREIGN (%)	EMPLOYMENT PRIVATE SECTOR INDUSTRY	CONSULTING	GOV'T	OTHER[3]	FACULTY[4] FULL TIME	PART TIME	INTERNSHIP/[5] APPLIED STUDY YES	NO	GRADUATE[6] FOLLOW-UP YES	NO
60/20/20	30%	50%	20%		8	0		X	X	
60/20/20	30%	50%	20%					X	X	
60/28/12	70%	6%	6%	18%	6	0	X		X	
60/28/12	70%	6%	6%	18%			X		X	
40/60/NA		55%	45%		7	10		X	X	
40/60/NA	10%	10%	80%					X	X	
NA/NA/NA		N/A	N/A	N/A	N/A	N/A		N/A	N/A	
59/38/3 37/58/5		8%	87%	5%	8	0		X	X	
97/3/0	N/A	N/A	N/A	N/A	1	9		X		X
60/35/5	21%	17%	41%	21%	7	0		X	X	
30/70/NA	25%		75%		8	0		X		X

TABLE

A SUMMARY PROFILE OF REPRESENTATIVE

STATE	INSTITUTION	PROGRAM	DEGREE	ENROLLMENT[1] FULL TIME	PART TIME	GRADUATES[2] No. / YEAR	CHANGE
PA	University of Pittsburgh	*Environmental and Sanitary Engineering	M.S.	30	30	35	Up
			Ph.D.	20	0	4	Stable
		*Industrial Hygiene and Air Engineering	M.S. M.P.H.	15	10	15	Up
SC	Clemson University	Environmental Systems Engineering	Ph.D.	10	N/A	3	Stable
		Natural Systems	M.S. M.Engr.	6	N/A	5	Stable
TN	Chattanooga State Technical Community College	Environmental[10] Technology	A.S.		N/A	N/A	N/A
	East Tennessee State University	Environmental Health	B.S.E.H.	146	0	47	Down
			M.S.E.H.	40	0	14	Down
	Middle Tennessee State University	Environmental Science and Technology	B.S.	31	31	12	Up
	University of Tennessee	Environmental Engineering	M.S.E.E. M.E.	32	21	16	Stable
			Ph.D.	4	0	3	Stable
	Vanderbilt University	Environmental Science	B.S.	9	0	4	Down

9

ENGINEERING/HEALTH PROGRAMS

STUDENT ORIGIN IN-STATE/ OUT-OF-STATE/ FOREIGN (%)	EMPLOYMENT PRIVATE SECTOR INDUSTRY	CONSULTING	GOV'T	OTHER[3]	FACULTY[4] FULL TIME	PART TIME	INTERNSHIP/[5] APPLIED STUDY YES	NO	GRADUATE[6] FOLLOW-UP YES	NO
50/50/0	40%	30%	30%		6	7		X	X	
25/62/18	40%	30%	30%					X	X	
25/62/18	40%	30%	30%					X	X	
50/50/0	60%		40%		0	37		X	X	
N/A	60%		40%					X	X	
50/50/0	60%		40%					X	X	
80/20/0	5%	90%	5%		0	14		X	X	
80/20/0	40%	40%	20%		2	0	X		X	
80/20/0	40%	40%	20%				X		X	
90/10/0	25%	45%	30%		10	0	X			X
50/50/0	25%	45%	30%		6	0		X		X
50/50/0	25%	45%	30%					X		X
50/50/0	25%	45%	30%					X		X
50/50/0	50%		30%	20%	0	40		X	X	
50/50/0	50%		30%	20%				X	X	
50/50/0	50%		30%	20%				X	X	
95/5/0	30%	50%	20%		8	0		X	X	

TABLE

A SUMMARY PROFILE OF REPRESENTATIVE

STATE	INSTITUTION	PROGRAM	DEGREE	ENROLLMENT[1]		GRADUATES[2]	
				FULL TIME	PART TIME	No. / YEAR	CHANGE
TN	Vanderbilt University	Environmental and Water Resources Engineering	B.E.	34	0	6	Up
		Environmental Science	M.S.	16	0	6	Stable
			M.Eng.	6	0	2	Up
			Ph.D.	10	0	2	Down
TX	Lamar University	Environmental Science	B.S.	125	0	15	Up
	Sam Houston State University	Environmental Science	B.S.	35	0	12	Stable
	Texas A & M University	Environmental Engineering	M.S.	14	0	3	Down
			Ph.D.	1	0	2	
UT	University of Utah	Environmental Engineering	B.S.	15	0	10	Stable
			M.S.	10	0	5	Stable
			Ph.D.	0	2	0	Stable
VA	Virginia Polytechnic* Institute and State University	Sanitary Engineering/ Environmental Sciences and Engineering/Civil Engineering	M.S.(San)	15	3	15	Stable
			M.S.(Env)	15	2	15	
			M.S.(Civ)	5	0	3	
			Ph.D.(CE)	4	0	2	

9

ENGINEERING/HEALTH PROGRAMS

STUDENT ORIGIN IN-STATE/ OUT-OF-STATE/ FOREIGN (%)	EMPLOYMENT				FACULTY[4]		INTERNSHIP/[5] APPLIED STUDY		GRADUATE[6] FOLLOW-UP	
	PRIVATE SECTOR INDUSTRY	PRIVATE SECTOR CONSULTING	GOV'T	OTHER[3]	FULL TIME	PART TIME	YES	NO	YES	NO
30/70/NA	25%		75%		8			X		X
10/90/NA	25%		75%		8			X		X
98/2/NA	90%		10%		10		X		X	
98/2/NA	60%		40%		3			X	X	
50/50/NA	80%		20%		9	6		X	X	
50/25/25	65%		35%		5	2		X		X
50/50/NA	65%		35%							
50/50/NA	60%		30%	10%						
60/40/0	25%	25%	40%	10%	7	6		X		X

TABLE

A SUMMARY PROFILE OF REPRESENTATIVE

STATE	INSTITUTION	PROGRAM	DEGREE	ENROLLMENT[1]		GRADUATES [2]	
				FULL TIME	PART TIME	No. / YEAR	CHANGE
VA	Virginia Polytechnic Institute and State University	*Sanitary Engineering/ Environmental Sciences and Engineering/Civil Engineering	Ph.D. (Env.Sci.)	4	0	2	Stable
WV	West Virginia University	*Environmental Engineering	M.S. M.S.E.	20	0	10	Stable
WI	University of Wisconsin at Madison	Civil and Environmental Engineering	B.S.	526	N/A	100	Up
		Water Resources Management	M.S.	72		20	N/A
		Environmental Monitoring	M.S.	7		N/A	
			Ph.D	7		N/A	
		Land Resources	M.S.	21		N/A	
			Ph.D.	14		N/A	

9

ENGINEERING/HEALTH PROGRAMS

STUDENT ORIGIN IN-STATE/ OUT-OF-STATE/ FOREIGN (%)	EMPLOYMENT				FACULTY[4]		INTERNSHIP/[5] APPLIED STUDY		GRADUATE[6] FOLLOW-UP	
	PRIVATE SECTOR									
	INDUSTRY	CONSULTING	GOV'T	OTHER[3]	FULL TIME	PART TIME	YES	NO	YES	NO
60/40/0	25%	25%	40%	10%	7	6		X		X
N/A	15%	10%	75%		5	3		X		X
85/10/5	35%		30%	35%	28	2	X			X
70/25/5	50%		50%			52	X		X	

Photo reprinted from the
Michigan Technological
University Catalog 1975-76

PROJECT COMMENTARY

Photo reprinted from the
University of Missouri,
Columbia Bulletin 1977

PROJECT CONSTRAINTS

In preparation for the on-site interviews, all of the institutions' catalogs were intensively reviewed in order to determine where environmental programs were being offered. During the course of this study, 171 institutions were visited and a total of 338 environmental programs, representing 45 states and Washington, D.C., were surveyed in detail. Albeit significant, these programs represent only a portion of all such programs available and cannot be construed as an in-depth survey of all environmental programs. It is, however, a representative sample within each of the environmental pollution control areas of Air, Noise, Pesticides, Radiation, Water and Wastewater, Solid Waste and Energy.

Several constraining factors to the proposed comprehensiveness of the study were encountered while collecting data from the institutions. It was disappointing to find that definitive records or statistics were generally unavailable which would describe specifically the placement of environmental program graduates. General indications of placement within categories, such as government or industry, were often available in percentages only. Depending on the size of the program and its age, some contact people could describe all graduates, others knew only where the past year's graduates were presently employed, and still others were aware only of their advisees entry-level positions and subsequent moves.

It also became clear during the on-site interviews that some programs of similar or identical content had different titles. This lack of clarity within the environmental areas serves to confuse the casual reader. For that reason, attention must be directed to the actual environmental course listings included in each program summary.

A list of terms commonly used during the on-site interviews and subsequently in this report was developed in order to facilitate precise data gathering. The reader is directed to Appendix II, TERMINOLOGY.

No attempt was made, in this report, to qualitatively judge any of these programs. The apparent absence of substantial qualitative measures in the environmental education field in general and the desire to collect data in a neutral atmosphere underscore the reasons for this omission. It appears that there is a need for the development of an environmental program model in each of these areas in order that some qualitative standards be provided where none now exist.

PROJECT COMMENTARY

The preceding analyses of data gathered from Environmental Engineering/Health programs indicate those trends and future projections that can be made given quantitative information from project participants. To synthesize and summarize, enrollments and workforce production in these composite programs are generally stable or increasing. Employment profiles indicate larger percentages of graduates enter industry and government service than consulting or teaching. Shifts in job placement cannot be determined from available data. Program personnel, for the most part, were able to categorize entry-level positions. Subsequent occupational transfers were not identifiable unless extensive graduate follow-up procedures were utilized. Several generalizations regarding employment trends may be ascertained by examination of the individual program summaries.

Future curriculum modifications reflect, among other things, job market demands, geographical location, legislative mandates, and growing environmental concerns. Courses recently developed in response to Environmental/Energy issues are indicative of the educational community's capacity to utilize regional resources in training and conceivably its ability to generate workforce personnel. Sanitary engineering programs, which are historically water- and wastewater-oriented, are expanding to include courses in air, solid waste, and even radiation. Comments from a number of survey participants indicate planned curricular expansion encompassing industrial hygiene, toxicology, radiation, and environmental health areas; many programs are planning course work in the energy area. Such curriculum modifications may well result in shifting numbers of graduates trained in any given environmental area. Detection of substantive changes in workforce capacity will require careful monitoring of enrollment and graduate statistics.

Environmental engineering/health educators are divided in their views regarding the breadth and specialization needed in training programs. Some maintain that graduates from bachelors and advanced degree programs are better prepared having received traditional engineering degrees and that specialization comes with employment experience. Others, particularly those at the sub-baccalaureate level, contend that training programs must recognize and prepare students for immediate workforce needs--that training must be highly application-oriented and practical. Another sentiment expressed by some is that programs must more effectively integrate training in a number of environmental areas (e.g., air, solid waste, wastewater) within single programs in order that graduates of these programs can deal capably with the complex, inter-relational demands of environmental pollution and its control and abatement. Varying views are undoubtedly the result of varying faculty backgrounds and degrees of past success in placing graduates. Personnel in the educational community want to prepare students for jobs that do exist, yet are hard-pressed to identify what those jobs are. Communication between post-secondary environmental programs and the private sector and government agencies that employ graduates of those programs is critical if environmental workforce needs are to be adequately met.

The future of Environmental Engineering/Health training programs, according to contact persons surveyed in this Phase II study, is generally positive. However, any level of optimism is highly and positively correlated with continued financial support and stable enrollments. Most program personnel regard these factors as highly unstable and dependent upon complex economic, political, and social developments.

LIST OF COMPOSITE TRAINING INSTITUTIONS BY DEGREE

Photo reprinted from the
Northland College Catalog
1975-76

LIST OF COMPOSITE ENGINEERING/HEALTH
TRAINING INSTITUTIONS BY DEGREE

CERTIFICATE

Georgia Institute of Technology (graduate level)

ASSOCIATE

Chattanooga State Technical Community College
*Delaware Technical and Community College
Delgado College
Hocking Technical College
*Middlesex County College
*Muskingum Area Technical College
OSU Oklahoma City Technical Institute
Oscar Rose Junior College
Raymond Walters General and Technical College
*Springfield Technical Community College

BACHELORS

California Polytechnic State University
Catholic University
East Central Oklahoma State University
Florida International University
Lamar University
Middle Tennessee State University
*Purdue University
Sam Houston State University
Slippery Rock State College
Syracuse University
University of Georgia
Western Kentucky University

MASTERS

Howard University
New Jersey Institute of Technology
The Cooper Union
University of Alabama
University of Alaska
*West Virginia University
*Yale University

ENVIRONMENTAL ENGINEER

Massachusetts Institute of Technology

MULTIPLE DEGREES OFFERED BY ONE INSTITUTION

Diploma/Associate

Kirkwood Community College

Associate/Bachelors

Ferris State College
*Temple University

Bachelors/Masters

Clarkson College
East Tennessee State University
Hunter College
McNeese State University
Ohio University
University of Louisville
University of Toledo

Bachelors/Masters/Doctoral

*Carnegie Institute of Technology
*Cornell University
Kansas State University
Michigan State University
*Ohio State University
*Rensselaer Polytechnic Institute
*The Pennsylvania State University
University of Arkansas
*University of Michigan
University of Oklahoma
*University of Pittsburgh
University of Utah
University of Wisconsin at Madison
Vanderbilt University

Masters/Doctoral

California Institute of Technology
Clemson University
*Drexel University
Duke University
Heed University
Johns Hopkins University
North Carolina State University
Polytechnic Institute of New York
*Rutgers State University of New Jersey
Stevens Institute of Technology
Texas A & M University
*University of Cincinnati
University of Delaware

MUTLIPLE DEGREES OFFERED BY ONE INSTITUTION

Masters/Doctoral (continued)

University of Kansas
*University of Maine
University of Minnesota
University of North Carolina
University of Tennessee
*Virginia Polytechnic Institute & State University

NON-DEGREE

Kansas State University - Institute for Environmental Research
Ohio State University - Cooperative Extension Service Activities
Princeton University - Energy Conversion and Resource

* Denotes that the program appears in another volume(s).

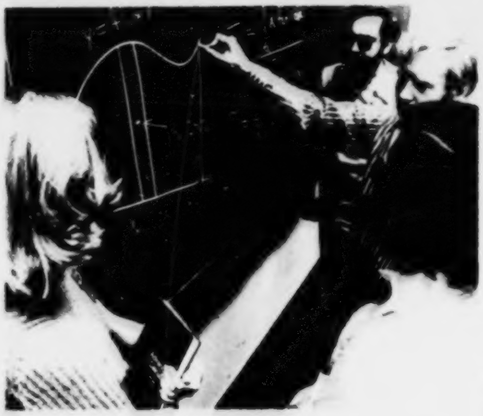


Photo reprinted from the
Illinois Institute of Technology
Booklet

COMPOSITE TRAINING SUMMARIES

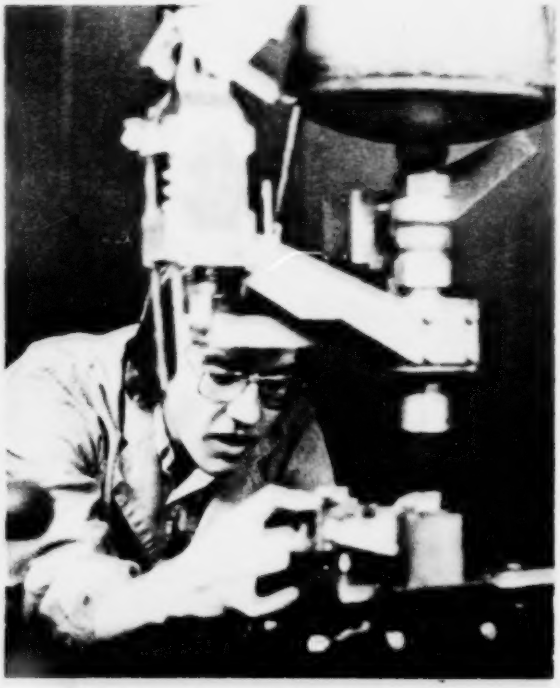


Photo reprinted from the 1976-77 Annual Report,
Engineering Experiment Station, College of Engineering,
University of Wisconsin, Madison

ENGINEERING/HEALTH TRAINING SUMMARIES

Volume I

Institution Page

California Institute of Technology 109
California Polytechnic State University. 113
Carnegie-Mellon University Carnegie Institute of Technology 117
Catholic University of America 121
Chattanooga State Technical Community College. 125
Clarkson College 129
Clemson University
    Environmental Systems Engineering. 133
    Natural Systems. 139
Cornell University
    Environmental Engineering. 145
    Waste Management Engineering 151

Delaware Technical and Community College 155
Delgado College. 159
Drexel University. 163
Duke University. 167

East Central Oklahoma State University 171
East Tennessee State University. 175

Ferris State College 187
Florida International University 191

Georgia Institute of Technology. 195

Heed University. 199
Hocking Technical College. 203
Howard University. 207
Hunter College 211

Johns Hopkins University 215

Kansas State University
    Chemical Engineering 219
    Institute of Environmental Research. 223
    Mechanical Engineering 225
Kirkwood Community College 229

Lamar University 233

McNeese State University 237
Massachusetts Institute of Technology. 241
Michigan State University. 245
Middle Tennessee State University. 251
Middlesex County College 255
Muskingum Area Technical College 259

New Jersey Institute of Technology 265
North Carolina State University. 269

ENGINEERING/HEALTH TRAINING SUMMARIES

(See Volume I - cont'd. for these program summaries)

Institution Page

Ohio State University

  Agricultural Engineering 275
  Civil Engineering. 279
  Environmental Biology. 287
Ohio University 295
Oscar Rose Junior College 301
OSU Oklahoma City Technical College 303

Polytechnic Institute of New York 307
Purdue University 311

Raymond Walters General and Technical College of the
  University of Cincinnati. 315
Rensselaer Polytechnic Institute. 319
Rutgers - State University of New Jersey. 325

Sam Houston State University. 329
Slippery Rock State College 331
Springfield Technical Community College 335
Stevens Institute of Technology 339
Syracuse University 343

Temple University 347
Texas A & M University. 351
The Cooper Union. 355

The Pennsylvania State University

  Environmental Engineering 359
  Environmental Pollution Control 365

University of Alabama 369
University of Alaska. 373

University of Arkansas

  Agricultural Engineering. 377
  Environmental Science, Civil and Environmental
    Engineering 381

University of Cincinnati

  Air Pollution, Industrial Hygiene 387
  Civil and Environmental Engineering 393
  Environmental Health. 399
  Occupational Medicine 403
University of Delaware. 407
University of Georgia 411
University of Kansas. 415
University of Louisville (Speed Scientific School). 421
University of Maine - Orono 427

University of Michigan

  Environmental Sciences Engineering. 431
  Industrial Hygience and Air Pollution 435

ENGINEERING/HEALTH TRAINING SUMMARIES (cont'd.)

Institution Page

University of Minnesota 441
University of North Carolina at Chapel Hill 447
University of Oklahoma. 455
University of Pittsburgh
    Environmental and Sanitary Engineering 461
    Industrial Hygiene and Air Engineering 467
University of Tennessee 471
University of Toledo. 477
University of Utah. 485
University of Wisconsin - Madison
    Civil and Environmental Engineering. 491
    Water Resources Management, Environmental Monitoring, Land Resources 497

Vanderbilt University
    Environmental and Water Resources Engineering/ Environmental Science (graduate) 503
    Environmental Science (undergraduate). 509
    Environmental and Water Resources Engineering (undergraduate). 513
Virginia Polytechnic Institute and State University 517

West Virginia University. 521
Western Kentucky University
    Environmental Engineering Technology 525
    Environmental Science. 529

Yale University 533

INSTITUTION: CALIFORNIA INSTITUTE OF TECHNOLOGY

PROGRAM: Environmental Engineering Science

DEPARTMENT: Interdisciplinary

DEGREE: Master of Science (M.S.), Doctor of Philosophy (Ph.D.)
Environmental Engineering Science

CONTACT: Dr. Jack E. McKee
Professor, Environmental Engineering
W.M. Keck Laboratory, Room 105
California Institute of Technology
Pasadena, California 91125
(213) 795-6811

PROGRAM DESCRIPTION:

PROGRAM STRUCTURE

Environmental studies have been available at Cal Tech for many years. Over 20 years ago, Professor Haggen-Smit demonstrated that the primary smog producers were automobiles and power plants, and not backyard incinerators as many people had believed. In 1960, the environmental health engineering program was established. Many of the faculty currently active in the program, were recruited at that time.

In 1969, in response to national concerns, and faculty and student interest, a new interdisciplinary program was established. With the inception of the new program, advanced degrees in environmental engineering science were offered.

The scope of the program includes the current issues of protection and control of man's environment. Faculty members from the Division of Engineering and Applied Science, Chemistry and Chemical Engineering, Humanities and Social Sciences, and Geological and Planetary Sciences cooperate in this interdisciplinary program. The program is strongly research oriented and each student is expected to plan for both breadth of environmental studies and depth of research in a particular subject.

Within the program are nine major areas of specialization. A student may choose: air quality control; environmental engineering; environmental economics and policy studies; environmental geochemistry; hydraulics and water resources; marine ecology; water chemistry; water supply and pollution control; or, wastewater reclamation and reutilization. Excellent laboratory facilities are available at the university. Studies in diffusion, turbulence, sediment transport and stratified flow are conducted at the Keck Laboratory of Hydraulics and Water Resources. Keck Laboratory is equipped with air quality instruments for measurements of gaseous and particulate atmospheric pollutants, which may be interfaced with a computer system for on-line data analyses. The Water Quality Laboratory is equipped for trace element analyses as well as microbiological measurements. The Kerckhoff Laboratory, located at Corona del Mar, is the research base for work in marine ecology.

Closely associated with the environmental engineering science program is the Enviornmental Quality Laboratory (EQL). The EQL is an independent research unit devoted to the study of policy questions in environmental protection and control. EQL research projects are often closely related to individual research efforts in the academic divisions. EQL research projects provide the framework for a comprehensive view of environmental control problems and alternative solutions.

PROGRAM REQUIREMENTS

The curriculum has been developed primarily for students pursuing the Ph.D. degree. The purpose of the Ph.D. program is to prepare students for careers in specialized research, advanced engineering, and planning and management of various environmental projects. The M.S. degree is offered for students choosing environmental engineering careers in engineering design, planning or management.

Minimum requirements for the Master of Science include successful completion of 135 quarter units of advanced courses. There are 108 quarter units of restricted electives and the remaining 27 units are for free electives of any graduate courses at the Institute. There is no thesis requirement for the master's degree.

Before a student can be recommended for admission to candidacy for the Ph.D. degree in environmental engineering science, the student must complete a series of advanced courses as arranged in consultation with the advisory committee. The student must also successfully complete at least 27 quarter units of course work in advanced mathematics or a satisfactory substitute. Finally, the student must pass a candidacy examination on the major subject. In order to broaden the student's program, at least 45 quarter units must be completed in a minor. The subject minor requires the approval of the environmental engineering faculty. A thesis and a final oral examination must be completed before the degree may be conferred.

CURRENT FACULTY, STUDENTS, GRADUATES

The faculty of Cal Tech is composed of some of the most outstanding scholars in the world today. The environmental engineering program is a beneficiary of this academic excellence. Some current topics being studied are water quality and wastewater treatment, air pollution and its effects on the human respiratory tract, and air pollution control strategies. The number of faculty directly involved in the program consists of nine that are teaching environmental engineering courses, and nine supporting faculty from other disciplines. Faculty are involved in both teaching and research. However, a small number are supported directly through research grants and must devote all of their time to such activities.

Currently, there are 27 graduate students in the program. This number varies little from year to year. The number of students in the master program is seven. Because the master's is usually completed in one year, about seven master's degrees are conferred annually. The Ph.D. program is somewhat larger. Currently, approximately 20 students are involved. The average number of students receiving their degree is four to five per year. Environmental Engineering is one of the larger programs in engineering at Cal Tech. Only physics and chemistry have more declared majors than environmental engineering.

Cal Tech graduates have no problem in securing employment in their field. At present, there are more requests than there are graduates. About 25% of the Ph.D. students elect university teaching. The majority of both Ph.D. and M.S. graduates become employed with consulting firms (50%). Less than 20% of Cal Tech graduates are employed by the public sector.

Historically, the number of women and foreign students have been small at the Institute. Only 5% of environmental engineering students are women and between 5% to 10% are foreign. Almost 80% of the students are from out of state.

Financial assistance is limited. Well qualified students, however, may receive teaching and research assistantships, industrial fellowships or tuition scholarships. all awarded by the Institute.

PROGRAM PROJECTIONS

Significant changes in faculty, student size or curriculum are not anticipated for the next few years. Environmental engineering at Cal Tech is looked upon as exemplary, and is one of the outstanding programs in the nation today. The Institute hopes to continue this reputation of excellence.

COURSE DESCRIPTION

Env 100 Special Topics in Environmental Engineering - Special courses, problems or research for graduate students working for the M.S. degree or qualified undergraduates. (6+ q.h.)

Env/GE 103 abc Oceans and Atmospheres - Natural physical and chemical processes in the earth's fluid envelope. (9 q.h.)

Env 112 abc Hydrologic Transport Process - The hydrologic cycle and its relation to man; statistical analysis and simulation of hydrologic data. (9 q.h.)

Env 116 Experimental Methods in Air Pollution - Methods of sampling and measurement of particulate and gaseous pollutants with applications to pollution sources, gas cleaning equipment, and smog formation. (9 q.h.)

Env 142 ab Chemistry of Natural Water Systems - Chemistry of electrolyte solutions, heterogeneous processes, and redox reactions applied to quantitative description of natural waters. (9 q.h.)

Env 143 Water Chemistry Laboratory - Laboratory experiments and measurements dealing with the major and minor constituents of natural waters. (9 q.h.)

Env 144 Ecology - Basic principles of ecology and ways in which human activities can influence natural populations. (6 q.h.)

Env 145 ab Environmental Biology - An exposition of basic biological principles concerning interrelations between organisms, particularly those directly affecting man and his environment. (10 q.h.)

Env 146 abc Analysis and Design of Water and Wastewater Systems - The application of science and engineering sciences to water supply and treatment for municipal use. (9 q.h.)

Env 150 abc Seminar in Environmental Engineering Science - Seminar on current developments and research within the field of environmental engineering science, with special consideration to work at the Institute. (1 q.h.)

Env 155 Special Problems in Waste Management - Environmental pollution related to nuclear energy; solid wastes from municipalities, industries, and agriculture; transportation and storage of hazardous materials, and detailed case studies of specific problems. (9 q.h.)

Env 156 Industrial Wastes - The production and characteristics of liquid industrial wastes; their effects upon municipal sewage treatment plants, receiving streams, and groundwaters. (9 q.h.)

ChE/Env 157 ab Fundamentals of Air Pollution Engineering - Basic concepts necessary to understand the sources, control and atmospheric behavior of air pollutants. Air quality and emission standards; sources, quantities, and nature of emissions. (9 q.h.)

Env 170 ab Aerosol Science - Physics and chemistry of small particle behavior with applications to gas cleaning, air pollution, and air chemistry. (9 q.h.)

Env 200 Advanced Topics in Environmental Engineering Science - Special topics in the application of engineering principles to biological and medical problems.

Env 206 Special Problems in Biological Engineering Science - Special topics in the application of engineering principles to biological and medical problems.

Env 250 Advanced Environmental Seminar - A seminar course for advanced graduate students and staff to discuss current research and technical literature on environmental problems. (4 q.h.)

INSTITUTION: CALIFORNIA POLYTECHNIC STATE UNIVERSITY

PROGRAM: Environmental Engineering

DEPARTMENT: Environmental Engineering

DEGREE: Bachelor of Science (B.S.) in Environmental Engineering

CONTACT:
Dr. Harold M. Cota
Environmental Engineering
California Polytechnic State University
San Luis Obispo, California 93407
(805) 546-2589

PROGRAM DESCRIPTION:

PROGRAM STRUCTURE

The environmental engineering program was developed in 1968 at California Polytechnic State University. At the time of inception, the program emphasis was on air pollution control and air-conditioning-refrigeration. In 1972, a new area was added to the program: water pollution-waste management.

The program offers the student a sound base in the fundamentals of engineering, and an area of concentration in one of the previously mentioned options. Approximately 60% of the students choose the air pollution and water pollution-waste management areas of specialization.

Graduates of this program find employment with private consulting firms, manufacturers, contractors and with governmental agencies. Examples of occupations which are selected by graduates include: air pollution control engineer; air pollution control inspector; audiologist; environmental engineer (noise); chemical engineer; water quality engineer; and, water pollution control engineer.

PROGRAM REQUIREMENTS

Qualified students of any high school may be admitted to California Polytechnic State University. Admission, however, is limited to those students for whom the university has adequate staff and facilities.

The Bachelor of Science degree requires completion of from 186 to 210 quarter hours or units. A minimum of 63 quarter hours are required from general education courses.

During the first year of the environmental engineering program, the student, in addition to the regular university courses and electives completes the introductory environmental engineer course. During the second year, this student will complete two environmental courses: environmental engineering measurements, and heating and ventilation. During the third and fourth years, students complete the following environmental courses, in addition to the regular curriculum: noise and vibration control; heat transfer; environmental air qualtiy; advanced mass and energy transfer; automatic process control; advanced system design; and, senior project and undergraduate seminar.

In addition to the course work, students are encouraged to work for federal, state and local agencies during the summer, between the junior and senior years.

CURRENT FACULTY, STUDENTS GRADUATES

At present the faculty for the environmental engineering programs totals six full-time teaching and administrative personnel. All six members are cost-centered.

Enrollment currently totals 161 full-time students. Of this total, 131 are male and 30 are female. Usually, this program does not attract the adult career change student. Normally, the program graduates approximately 25 students annually. Approximately 2% of these graduates elect to pursue their educational endeavors. The remaining 98% find employment in the private sector predominantly (70%). Approximately 30% of the graduates, however, enter employment with federal, state and local agencies.

PROGRAM PROJECTIONS

Significant changes in the faculty and in the student enrollment are not anticipated over the next few years. The program, according to the faculty, has stabilized. Substantive changes in the program structure are also not expected in the near future.

COURSE DESCRIPTION

EnvE 101 Introduction to Environmental Engineering - Nature and scope of the field of environmental engineering. (1 q.h.)

EnvE 251 Environmental Engineering Measurements - Experimental studies of the instrumentation and basic measurements of concern to the environmental engineer. (2 q.h.)

EnvE 309 Noise and Vibration Control - Behavior of sound waves, selection of instrumentation, practical measurements, criteria for noise and vibration control in environmental systems. (3 q.h.)

EnvE 321 Solar Energy - Methods of utilizing solar energy. Energy concepts. Collection and storage systems; greenhouse effect. (3 q.h.)

EnvE 324 Introduction to Air Pollution - Causes and effects of air pollution on the individual, the community and industry. (3 q.h.)

EnvE 325 Environmental Air Quality - Consideration of ambient air contamination inside and outside of a control space. (3 q.h.)

EnvE 326 Air Pollution Measurements - Planning and conduct of atmospheric surveys. Collection, evaluation, and interpretation of data as they pertain to the concentration of pollutants sampled. (3 q.h.)

EnvE 327 Water Pollution - Sources of pollution. Water quality standards. Principle techniques and operation. (3 q.h.)

EnvE 330 Environmental Quality Control - Aspects of the total environment. Application of scientific and engineering principles to control the development and use of air, water and land resources. (3 q.h.)

EnvE 411 Air Pollution Control - Theory, principles and practices related to the control of particulate emissions. Mechanical separations. (3 q.h.)

EnvE 421 Advanced Air Pollution Control - Theory, principles and practices related to the control of gaseous emissions. (3 q.h.)

EnvE 422 Environmental Radiation Surveillance - Sources of radioactive contaminants, biological effects, radiation protection. (2 q.h.)

EnvE 423 Industrial Environments - Effects of the environment in relation to health and the performance of work. (2 q.h.)

EnvE 434 Water Quality Measurements - Methods employed in the qualitative and quantitative determinations of water and waste water constituents. (2 q.h.)

EnvE 435 Water and Wastewater Treatment - Unit operations and unit processes encountered in potable water and wastewater treatment. (3 q.h.)

EnvE 438 Water and Wastewater Treatment - Application of the physical operation, and chemical and biological unit processes principles to the analysis and design of potable water and wastewater treatment facilities. (3 q.h.)

EnvE 439 Solid Waste Management - Chemical and physical properties of municipal and industrial refuse. Landfill disposal, incineration, composting. Industrial and commercial solid waste disposal. (2 q.h.)

INSTITUTION: CARNEGIE-MELLON UNIVERSITY
CARNEGIE INSTITUTE OF TECHNOLOGY

PROGRAM: Environmental Engineering

DEPARTMENT: Civil Engineering

DEGREE: Bachelor of Science (B.S.), Master of Science (M.S.),
Master of Engineering (M.E.), Doctor of Philosophy (Ph.D.)

CONTACT: Dr. Francis Clay McMichael
Head, Department of Civil Engineering
Carnegie-Mellon University
Carnegie Institute of Technology
5000 Forbes Avenue
Pittsburgh, Pennsylvania 15213
(412) 621-2600

PROGRAM DESCRIPTION:

PROGRAM STRUCTURE

Environmental engineering is not emphasized as a formal program at the Carnegie Institute of Technology. Emphasis is placed on research on environmental topics which is mainly conducted by departments of the College of Engineering. The principal areas of research are air pollution, industrial wastewater, solid waste management and energy. The prinicpal degree granting departments in the College conducting environmental research are the Chemical, Civil, Mechanical and Engineering and Public Policy Departments. The Engineering and Public Policy Department is also part of the Graduate School of Urban and Public Affairs. All of these departments are involved in undergraduate projects and graduate thesis research in the field of environmental engineering.

Selected institutes or research programs of the Carnegie Institute of Technology which are involved in environmental engineering are the Environmental Studies Institute (to be renamed the Center for Energy and Environmental Studies) which grants an M.E. in Environmental Studies, and the Division of Nuclear Science and Engineering.

The Department of Civil Engineering offers a graduate study option in Environmental Engineering. Emphasis is on water and wastewater treatment and management, and students receive a sound understanding of water science and water process technology. The Department cooperates with other departments and colleges within Carnegie-Mellon University to sponsor interdisciplinary programs leading to special degrees or joint degrees.

Research facilities for use of students in the program include an Environmental Engineering Laboratory for research mainly in the areas of water and wastewater chemistry. A unit operation laboratory is also utilized for both teaching and research. A clean laboratory is presently under construction for aerosol studies. Analytical facilities are available to measure common inorganic and organic indices of water quality.

PROGRAM REQUIREMENTS

The Department of Civil Engineering offers a variety of degrees at the Master's level. They include: M.S. in Civil Engineering; M.S. in Civil Engineering/Engineering and Public Policy; and Master of Engineering. The Master of Science degree requires a minimum of 96 academic units consisting of:

(1) at least 36 units of graduate courses in Civil Engineering;
(2) a minimum of 24 (a maximum of 42) units of graduate project,
(3) other approved courses as suggested by the faculty advisor, and;
(4) satisfactory completion of either a comprehensive final examination or an M.S. thesis.

The Department's Master of Engineering degree normally requires a minimum of 192 units of work with strong emphasis on interdisciplinary project work. Students register in an engineering department but select problems drawn from areas such as the environment. Ph.D. cnadidates complete an additional two years of graduate study beyond the M.S. degree. A qualifying examination and final examination are required, but no foreign language is required. There is a one-year residence requirement for the Ph.D.

Research assistantships, teaching assistantships and fellowships are offered to graduate students as financial aid. A much greater number of assistantships is available in comparison with the number of fellowships. Graduate assistantships are usually one-third time appointments requiring 12 hours of work for the Department weekly.

CURRENT FACULTY, STUDENTS, GRADUATES

The College of Engineering faculty, totaling about 90, teach both undergraduate and graduate students. The faculty devote about 67 percent of their time to teaching and 33 percent to research activities. The Civil Engineering faculty is composed of thirteen members, of whom six are full professors. Three professors have research interests in environmental engineering areas.

During 1977, the College of Engineering had research expenditures totalling about $6 million; of that amount, $3 million was for energy research, and one-third of the energy expenditures ($1 million) was for environmental-energy research. The main funding source is the National Science Foundation, and ten percent is provided by industry.

The College of Engineering has a total undergraduate enrollment of 1,200 students, most of which are full-time. Approximately 90 percent are male. There are about 400 graduate students (5% female) and approximately 40 are part-time. It is estimated that 350 stu dents annually complete the baccalaureate requirements and 100 students earn advanced engineering degrees. In Civil Engineering, twenty students were enrolled in the Master's programs in the fall of 1976, and eight students were enrolled in the Ph.D. program. During the 1975-76 school year, 34 students earned undergraduate degrees, 19 earned Master's degrees and two students received the Ph.D.

Approximately twenty percent of the students receiving B.S. degrees continue directly to graduate schools. It is expected that all graduates obtain employment directly in their field and 70 percent obtain positions in the private sector. Although the university maintains a Placement Office, students are also very successful in obtaining employment through individual contacts.

PROGRAM PROJECTIONS

Emphasis in the environmental engineering program in future years will remain on industry and the attempt to solve environmental and energy, fuel substitution, solar energy, and increased coal use problems. The Civil Engineering Department has no intention of developing a separate undergraduate major in environmental engineering. No change is foreseen in the institutional arrangements for degrees, but an increased emphasis on energy/environmental problems is expected. One additional faculty member was recently added to the environmental engineering program in the Civil Engineering Department. He has a doctorate, and his research interests include air pollution, and specifically, in trace metals in aerosols.

COURSE DESCRIPTIONS

12-721 Dynamic Hydrology - A theoretical basis is provided for analyzing water movement within the hydrology cycle; survey of important principles used in the analysis of ground water flow with applications to basin-wide ground water management; the design of industrial and domestic land and deep well waste disposal systems and to the prevention of water problems in coal mining operations; and other topics. (9 s.h.)

12-722 Wastewater Treatment: Theory and Design - Theory and design of wastewater treatment unit operations including sedimentation, activated sludge, and biological filtration. Material covered includes biological process kinetics, and theory and practice of advanced wastewater treatment processes. The design of solid handling systems focuses on thickening, digestion, incineration, and terminal disposal facilities. Laboratory sessions illustrate chemical principles of dilute aqueous systems and provide familiarity with chemical measurements commonly used in water and wastewater engineering. (9 s.h.)

12-723 Water Resources Chemistry - A rigorous yet practical basis for applying the principles of chemical equilibrium and kinetic models and physical chemistry to a description of the composition of waters and to water and wastewater treatment processes. Laboratory sessions illustrate chemical principles of dilute aqueous systems and provide familiarity with chemicals measurements commonly used in water and wastewater engineering. (9 s.h.)

12-732 Special Topics in Environmental Engineering - Development and application of models for assessing environmental problems with an emphasis on air pollution. Both elementary and more advanced models will be discussed. Consideration will be given to causes and effects of air pollution, control technologies, energy consumption rates and costs, and the need for efficient data collection and management. The course also includes studies of modeling atmospheric transport of air pollutants from source to sink. Offered from time to time as demand warrants. (9 s.h.)

INSTITUTION: THE CATHOLIC UNIVERSITY OF AMERICA

PROGRAM: Civil Engineering
DEPARTMENT: Civil Engineering
DEGREE: Bachelor of Science (B.S.)

CONTACT: Dr. Timothy Kao
620 Michigan Avenue, N.E.
Department of Civil Engineering
The Catholic University of America
Washington, D.C. 20064
(202) 635-5163

PROGRAM DESCRIPTION:

PROGRAM STRUCTURE

The four-year professional program leads to the Bachelor's degree in Civil Engineering, and is fully accredited by the ECPD (Engineers' Council for Professional Development). The program emphasizes the major career lines of civil engineering: structures and structural engineering, water resources and environmental engineering, and transportation and system engineering. The first two years are the same as other engineering programs, the third year introduces civil engineering specializations, and the senior year is marked by the large selection of program electives, a feature introduced for the students so they can pursue one or two specializations in depth or a diversified set of courses.

The facilities at Catholic University, known throughout the world, are made available not only to the faculty, but also to the undergraduates in the civil engineering program. Students are further encouraged to participate in the current research projects. Faculty thus are encouraged to make available to the students the results of the ongoing research activities. Catholic University presently has one of the best photoelasticity laboratories in which students conduct many dynamic tests which deal with impact, fatigue, and creep of metals; tensile tests of metals and plastics; and failure analysis of soils and concrete.

The program also offers workshops and seminars in construction management for professional engineers, and conducts a co-op program, in which the student works one semester and studies the other semester.

PROGRAM REQUIREMENTS

In order to enter the Civil Engineering program, students must meet University requirements. This includes an official report of scores recieved on the Scholastic Aptitude Test and three Achievement tests of the College Entrance Examination Board (CEEB), a transcript from the student's secondary school, and a recommendation from a counselor, principal, or teacher concerning the student's character. Once in the program, the student must take various required courses. A recommended program is outlined for students, but the student is carefully guided over the four-year period to ensure that his individual needs and special interests are met. The student is required to take several math and physics courses, plus chemistry, civil engineering and electrical engineering. Electives are offered in civil engineering and mechanical engineering courses.

Scholarships and financial aid are available through Department assistantships, the George Hyman Construction Company Scholarship, and through University scholarships. Forty percent of the students attending Catholic University receive financial aid.

CURRENT FACULTY, STUDENTS, GRADUATES

Currently there are nine members on the teaching staff, seven of these are full-time, eight of these are FTE, and two of these are adjunct. All nine do at least some research. The faculty receives its research funding from the National Institute of Health, the National Science Foundation, HEW, the Office of Naval Research, and through a contract with Water Resources Research Center in the Department of Interior.

There are seventy-two students enrolled in the program; sixty-two males and ten females, all full-time. The program attracts only a few "career change" students, and averages between fifteen and twenty graduates annually. The graduates are traced through alumni surveys conducted by the Alumni Department. It is found that thirty to forty percent of the graduates go on to further schooling. Of the remaining sixty to seventy percent, almost all go into employment in their field. One-half are privately employed and one-half are employed by the government. Those employed, found their jobs through personal efforts.

PROGRAM PROJECTIONS

The Department would like to expand the Civil Engineering program in the near future, specifically in the areas of Coastal Engineering and in Continuing Education for professionals. The Department would also like to offer new courses in professional advancement, but no new degrees are foreseen.

COURSE DESCRIPTION

(the following is a partial listing of courses)

Undergraduate courses:

CE 312 Theory of Structures I - Classification of structures. Criteria of stability. Degree of mobility of mechanisms. Equilibrium of statically determinate structures. Analysis of reactions and internal forces of statically determinate structures. Axial, shear, bending movement diagrams (qualitative and quantitative). Three-dimensional structural analysis. Trusses, cantilevered beams, three-hinged arches. Influence lines. (3 s.h.)

CE 361 Engineering Properties of Materials - Importance of materials. Factors governing material selection. Structure of materials, dislocations, grains, polymorphism. Mechanical properties. Mechanism of plastic deformation, slip, critical resolved shear stress fracture, hardness, ductility toughness, and their measurement. Fatigue of materials, creep, impact. Effects of environments, corrosion, temperature, erosion, wear, corrosion fatigue. Protection techniques. Manufacturing processes. Material selection. (3 s.h.)

CE 366 Soil Mechanics - Significance of soil properties in foundations. Internal forces in soils. Atterberg limits and soil classification. Normal and shear stresses in soils. Importance of soil properties and history of stresses in behavior of soils. (3 s.h.)

CE 372 Water Resources Engineering - An introductory course in hydrology and hydraulics which incorporates the following topics: the hydrologic cycle, measurement and interpretation of hydrologic data, estimating runoff, storage routing, reservoirs and dams, groundwater hydraulics and wells, open channel flow and flow in pressure conduits. (3 s.h.)

CE 395 Strength of Material Laboratory - Experimental determination of stress-strain curves of various materials, including tensile and compressive strengths and other material properties. Fatigue, hardness, Ixod impact, and cavitation erosion tests. Bending and torsion of beams. (3 s.h.)

CE 432 Laboratory Project - Students conduct laboratory projects under supervision of various faculty members. Experiments must be planned, instrumented, and results presented. (3 s.h.)

Graduate courses:

CE 501 Structural Mechanics I - Introduction to the theory of elasticity; plane stress and plane strain problems; stresses and strains in pressurized vessels; torsion; use of energy and variational methods in structural mechanics. (3 s.h.)

CE 590 Environmental Quality-Water Pollution - Pollutant classification and water quality standards: natural and manmade pollutants in fresh surface water and marine waters, chemical and physical nature of important water pollutants, thermal pollution, biological conditions prevailing in aquatic eco-systems, criteria for water quality standards. Transport of pollutants: sources, pathways, persistence, and fate of pollutants in estuaries, rivers, lakes, and oceans, hydrodynamic models, stratified flow and plume dynamics, numerical methods, physical and biological factors. Application to water quality, impoundment, thermal stratification in reservoirs and lakes, water quality control and management in reservoirs, oil spills on ocean surfaces. (3 s.h.)

CE 595 Water Supply Engineering - Introduction to the development of transportation, processing, and treatment of water and liquid waste; chemical and physical characteristics of surface and ground water; characteristics of municipal and industrial waste effluents; principles of design for physical, chemical, and biological uses; disposal of sludges and residues; socio-politico-economic aspects of water supply and pollution control. (3 s.h.)

CE 596 Sanitary Engineering and Water Quality Management - Theoretical and applied aspects of analysis and management of water and waste treatment processes of water and waste treatment processes of water quality control through systems analysis of the entire environmental water-shared system. (3 s.h.)

INSTITUTION: CHATTANOOGA STATE TECHNICAL COMMUNITY COLLEGE

PROGRAM: Environmental Technology

DEPARTMENT: Division of Engineering Technologies

DEGREE: Associate of Science in Environmental Technology

CONTACT: Mr. James Giesemann, Associate Professor
Chemical and Environmental Technologies
Division of Engineering Technologies
Chattanooga State Technical Community College
4501 Amnicola Highway
Chattanooga, Tennessee 37406
(615) 622-6262

PROGRAM DESCRIPTION:

PROGRAM STRUCTURE

This associate degree program was implemented in 1971 as an air pollution control training program, under a two-year grant from the U.S. Environmental Protection Agency. Expansion took place in 1976, with course offerings being made available in the fields of water and waste treatment, and stream biology. Since that time, graduates have been considered qualified for a variety of occupations, including air, water and stack sampler; air quality, water quality, and laboratory technician; environmental inspector, researcher, or consultant; and pollution control equipment manufacturer and salesperson.

The Environmental Technology degree program is no longer functional, although several of the courses are offered at this time. The program's demise is attributed to the lack of student interest; job opportunities are rare, and pay scales are low in the environmental field for graduates of two-year programs.

PROGRAM REQUIREMENTS

High school graduation or the equivalent (GED) is required for entrance into the college. There were no special prerequisites for the Environmental Technology program.

This program and its sister program, Chemical Technology, shared freshman year requirements, which include thirteen quarter hours of chemistry, fifteen hours of mathematics, eight hours of physics, two hours of drafting, and three hours each of composition, public speaking, and introduction to environmental pollution. During the sophomore year, those choosing the environmental option in Chemical and Environmental Technologies were required to take twenty-four hours in environmental technology. Additional courses during this year included the fields of chemistry, biology, computer science, electronics, English, and humanities. The number of quarter hours required for graduation in the environmental option was 105.

During a portion of its operational phase, the program cooperated with the Environmental Protection Agency's sampling network in the vicinity. Students assisted with sampling, and were paid for their efforts.

CURRENT FACULTY, STUDENTS, GRADUATES

Three faculty members were responsible for the administration and teaching responsibilities of this program during its peak. At the present time, one of these persons spends part-time teaching the two courses that are still offered. These courses may also be dropped from the college's offerings during 1978.

There have been seventeen graduates from this program. The first graduating class had nine in environmental technology, and the number graduating annually in this field has decreased steadily since that time to the present level of zero. Recruitment efforts were carried out, however, which included visits to local high schools, presentations at annual science fairs in local malls, and various other publicity. Nearly all those that have graduated from the program have found employment in the field, most in governmental agencies.

PROGRAM PROJECTIONS

Officials hope to keep the program functional to a small degree through a merger with Chemical Technology. Presently, this program offers more course work in the areas of organic chemistry, quantitative analysis, instrument analysis, and unit operations than had Environmental Technology. By combining these programs such that students acquire more expertise in these areas, thereby becoming more marketable, and offering several courses in environmental technology, students would be able to obtain skills necessary to enter environmental fields. Eventually, it is hoped that approximately ten persons will graduate annually in Chemical Technology that have taken environmental courses. This would keep the job market well supplied, if graduates would accept the low pay scales.

COURSE DESCRIPTION

ES 110 Introduction to Environmental Pollution - A brief introduction to the causes and effects of air pollution, the general methods of control, and governmental agencies and laws involved. Emphasis on effects. (3 q.h.)

ES 211 Meteorology and Climatology - A familiarization course covering general meteorology and climatology as applied to air pollution forecasting. An introduction to meteorological instruments. Effects of wind speeds, temperature inversions, and topography on air pollution levels. A visit to the National Weather Station. (5 q.h.)

ES 212 Air Pollution Control Methods - Introduction to the devices and methods for controlling the emission or particulates and gases from various industrial processes. A review of the operation of such equipment in local manufacturing plants. (4 q.h.)

ES 213 Environmental Sampling and Analysis I - A two-quarter sequence designed to acquaint the student with the problems of obtaining representative samples of the environment, and with the proper treatment of such samples to yield reliable information. Ambient air, smoke stacks, surface waters and sewage outfalls are sampled. Students perform the laboratory analyses by standard methods and visit installations where the work has been automated. (5 q.h.)

ES 214 Water and Wastewater Treatment - Purification of surface waters for municipal use with reference to the types of impurities to be removed and the methods of removal. Treatment of both municipal and industrial wastewaters. Trips to local treatment facilities to illustrate the size and operation of equipment. (4 q.h.)

ES 215 Air Pollution Laws and Regulations - Federal, state and local air pollution laws and regulations and the problems encountered in their enforcement. Coordinated with the local Air Pollution Control Bureau for practical problems in the field. (3 q.h.)

ES 223 Environmental Sampling and Analysis II - A continuation of ES 213. (5 q.h.)

INSTITUTION: CLARKSON COLLEGE

PROGRAM: Civil and Environmental Engineering

DEPARTMENT: Civil and Environmental Engineering

DEGREE: Bachelor of Science (B.S.); Master of Science (M.S.)
(in Civil and Environmental Engineering)

CONTACT: Dr. Norbert L. Ackerman
Chairman, Department of Civil and Environmental Engineering
Clarkson College
Potsdam, New York 13676
(315) 268-6529

PROGRAM DESCRIPTION:

PROGRAM STRUCTURE

The undergraduate curriculum at Clarkson College in Civil and Environmental Engineering is designed to provide an understanding of the fundamental principles of mathematics, mechanics, science, and humanities on which engineering is based. During the junior and senior years the program concentrates on various subjects in the field of civil and environmental engineering and through the selection of electives, proficiency can be developed in particular areas of interest. Elective concentrations include the areas of environmental engineering and water resources engineering.

The Civil and Environmental Engineering Department also offers a graduate program in Water Resources and Environmental Engineering. Bachelor of Professional Studies, Master of Engineering and Doctor of Philosophy (Engineering Science) degrees are also available to students enrolled in the department. The majority of the graduates enter professional practice in the fields of civil and environmental engineering.

PROGRAM REQUIREMENTS

Undergraduate applicants are required to complete sixteen units of secondary school, including the following ten academic units for admission to the School of Engineering: four units of English; four units of mathematics; and two units of science (one unit each of chemistry and physics). Admission to the graduate program is granted to applicants with an accredited baccalaureate degree in civil engineering and exceptional students with bachelor's degrees in other engineering disciplines will be considered.

Candidates for the baccalaureate degree must complete a minimum of 120 credit hours, complete the physical education or military science requirement, and achieve a minimum cumulative grade point average of 1.850. A minimum of thirty credit hours is required for the master's degree and at least twenty hours must be earned in residence. No foreign language requirement exists for this degree. A thesis and a non-thesis option is available. Thesis credit accepted towards the degree cannot exceed ten hours of credit. Fellowships and assistantships are available to graduate students enrolled in the department. Many New York state residents are eligible for the Tuition Assistance Program which provides $100 to $1,500 per year.

CURRENT FACULTY, STUDENTS, GRADUATES

A total of twenty-two faculty members contribute to the teaching of the department's curriculum. Twenty-one faculty are full-time. Research funding is provided from engineering foundations, private corporations, the U.S. Environmental Protection Agency, and the National Science Foundation.

There are currently (spring, 1978) an estimated total of 530 full-time students enrolled in the Department of Civil and Environmental Engineering (30 female). All students take at least one course in environmental engineering and approximately 20 to 30 percent (133 students) take two or more courses in this area. Enrollment has been consistently growing in the Department of Civil and Environmental Engineering and environmental engineering is considered to be a strong growth area. There are 25 students enrolled in the master's program, and approximately five are part-time.

At the baccalaureate level, there is an average of 120 students who annually receive the B.S. degree. Approximately eleven students annually receive the Master of Science degree. Of about twenty graduate students enrolled in the M.S. degree programs at any one time, twelve will graduate, six will drop out, and six will be enrolled as part-time students and take two to three years to complete the degree requirements.

It is estimated that 93 percent find employment that is directly related to their training, 4 percent in a related field and 3 percent find totally unrelated employment. The college's placement office is considered to have an excellent placement record. Placement statistics for 1975 and 1976 of Clarkson graduates show that over 77 percent were placed within three months of graduation. This includes 55 percent employed, 20 percent enrolled in graduate school, 2 percent engaged in military service, and 21 percent unreported. Of Civil and Environmental Engineering Department graduates, about 60 percent find private sector jobs and 40 percent find government positions.

PROGRAM PROJECTIONS

No changes in faculty staff or program structure are contemplated. No different degree programs are likely to be developed in the School of Engineering, as the college is at staffing and enrollment capacity.

COURSE DESCRIPTION (SELECTED)

Undergraduate courses:

CE 380 Environmental Engineering - An introduction to environmental engineering and environmental quality management. (3 s.h.)

CE 403 Civil Engineering Laboratory - A set of prescribed experiments is required related to the areas of mechanics, hydraulics, soils, materials and environmental engineering. (3 s.h.)

CE 479 Industrial Water Quality Management - A study of water supply and waste disposal problems of industry including technical and regulatory aspects. The nature of industrial wastes. Methodologies of industry waste surveys. (3 s.h.)

CE 484 Solid Wastes Engineering - The study of the principles of the collection, handling and disposal of municipal wastes, and disposal techniques including burial, composting, combustion, size reduction and densification. (3 s.h.)

CE 495 Special Projects in Civil and Environmental Engineering - An individual project is undertaken by the student under the guidance of a staff member. A complete report is required. (3 s.h.)

Advanced undergraduate and graduate courses:

CE 514 Groundwater and Seepage - Principles of confined and unconfined groundwater flow. Analysis by conformal mapping and graphical methods to determine the quantity of seepage, uplift pressures, and exit gradients. (3 s.h.)

CE 571 Water Resources - Consideration of physical, climatic, and economic geography; resources inventories; natural resource systems; conservation concepts; water supply and demand; economic, social and engineering objectives; water law, federal law, agencies, authorities and commissions; general principles of multiple-purpose regional planning; and other topics. (3 s.h.)

Graduate courses:

CE 671 Systems Design in Water Resources Development - Identification of design objectives in water resource development; system characteristics of a river basin; mathematical synthesis of hydrologic data; simulation and optimization; application to a multi-purpose river basin system design. (3 s.h.)

CE 681 Water Renovation Processes I - The theory of the chemical-physical processes employed in water and waste treatment technology. The laboratory stresses pilot plant experimentation with emphasis on process design. (3 s.h.)

CE 686 Environmental Facilities Design - Emphasis will be on water supply, waste conveyance, and treatment facilities design. Topics to be covered will include water distribution system design, sanitary sewer system design, water treatment plant design, and waste treatment plant design. (3 s.h.)

CE 698 Graduate Thesis or Special Projects - Analytical or experimental studies under the direction of a faculty member specially designated. A grade and/or credit for this work presented in satisfaction of the requirements for a degree is given when those requirements are completed. (1-10 s.h.)

INSTITUTION: CLEMSON UNIVERSITY

PROGRAM: Environmental Systems Engineering

DEPARTMENT: Environmental Systems Engineering

DEGREE: Doctor of Philosophy (Ph.D.)

CONTACT: Dr. Thomas M. Keinath, Professor and Head
Environmental Systems Engineering
Clemson University
Clemson, South Carolina 29631
(803) 656-3276

PROGRAM DESCRIPTION:

PROGRAM STRUCTURE

Doctoral level education in environmental systems engineering at Clemson University began in the early 1960s, along with the development of the master's programs in this field. At the master's level, the M.S. and the M.Engr. degrees are offered under four areas of specialization: Air Pollution, Planning and Management, Natural Systems, and Water Treatment Systems. These programs are described in separate summaries in the appropriate volumes of this report.

The Ph.D. program is flexible, and is formed around the background and ultimate objectives of the candidate. Specialization may be elected in any of several areas within the boundaries of the environmental systems engineering field.

Doctoral-level ESE students become involved in research on an individual basis in the preparation of the dissertation, and may work in conjunction with faculty members in the conduct of sponsored research projects. The department has attracted over two million dollars of outside funding since its formation. Past and present research activities have been in such areas as wastewater treatment processes, water resources planning, reservoir limnology, lake enrichment, power plant siting, urban water quality, analysis of pollutants, environmental monitoring, ecosystem response, environmental quality assessment, dynamic modeling, and air pollution control processes. Funding for ESE projects has come from sources as the U.S. Environmental Protection Agency, the U.S. Army, several state agencies, and private industry. Departmental research facilities include twelve research laboratories, a precision analytical instrument room, a two-story unit operations and processes laboratory, and a hybrid computer.

Members of the ESE faculty have produced textbooks and authored numerous papers, and have chaired and keynoted sessions nationally and abroad. Continuing education workshops in upgrading sewage lagoon performance, industrial wastes, air and water pollution, and operator training have been presented as a public service to industries and governmental personnel. The faculty is also very active in participating on national boards and commissions such as the EPA Training, Research and Effluent Guidelines Committees, the National Wildlife Federation, and the South Carolina Board of Certification for Environmental Systems Operators. All faculty members are also actively involved with a number of state and national professional associations.

PROGRAM REQUIREMENTS

Unlike the ESE master's level programs, there are no predetermined standard prerequisites for acceptance into the Ph.D. program of study. Normally, a master's degree in a related field along with high academic achievement is a determining factor for acceptance. Students with master's degrees in fields other than environmental engineering who are enrolled in the curriculum normally must elect core courses from the ESE master's curriculum. Those with an M.S. or M.Engr. in environmental engineering from other universities normally audit these courses.

Work leading to the Ph.D. is planned in such a way as to give the student a comprehensive knowledge of his or her field of specialization and a mastery of research methods. The degree is not granted solely on the basis of course work completed, residence, or other routine requirements. Rather, the main basis for the granting of the degree is the student's grasp of the subject matter, the competency to plan and conduct research, and the ability to express himself/herself adequately and professionally in oral and written language.

Each student selects a major advisor, and an advisory committee is selected by the department head, the major advisor, and the student. This committee approves the student's curriculum, supervises the graduate program, administers the comprehensive examinations, and initiates recommendations for the awarding of the degree.

The Graduate School requires that Ph.D. candidates select at least half of their courses from those numbered 800 and above. A minimum of eighteen hours of doctoral research is also required. Doctoral students may, but are not required to select one or more minor fields and demonstrate competency in the chosen minor(s). Areas suitable for minor specialization are chemistry, biology, physics, mathematics, chemical engineering, economics, operations research, and management. Minor area course work should be chosen to enhance the development of the student's research program. A minimum of twelve to twenty-four semester hours is required to satisfy the minor area(s) requirement. Either by formal course work or by self-study, the students are also expected to become familiar with the use of computers and the basic principles of systems engineering.

At the end of the first year of study, all candidates must take a qualifying examination. Comprehensive examinations are scheduled after the completion of course work in the minor area(s) and upon completion of the broadening requirements. The function of these examinations is to obtain objective evidence of an adequate intellectual mastery of the areas of major and minor specialization. Passage of the examinations allows the student to apply for degree candidacy. The research phase of the degree program leads to a dissertation, which is prepared under the direction of the major advisor. The final oral examination demands a broad and penetrating interpretation by the student of the research project and its conclusions, and may include examination in the major and minor field(s) of specialization.

Approximately 95 percent of all ESE graduate students receive financial support. This comes from assistantships, fellowships, and various training grants.

CURRENT FACULTY, STUDENTS, GRADUATES

Seven full-time faculty members comprise the ESE department. Their teaching and research interests represent a broad range of topics and specialties within the broad field of environmental systems engineering. These faculty members all have responsibilities with the Ph.D., as well as the master's degree programs.

There are currently ten students enrolled in the ESE doctoral program. An average of approximately three completes the degree each year. Ph.D. graduates typically become faculty members of colleges or universities, or become expert researchers with private or governmental organizations. Others become administrators of environmental programs, also either in the public or the private sector.

PROGRAM PROJECTIONS

Within several years, the ESE Department's total enrollment is expected to grow from its present average of forty to forty-five, to approximately sixty. Some of this growth may take place in the doctoral program. Additionally, the ESE faculty will in the future place more emphasis on the control of toxic pollutants in the course work offered and in its research activities.

COURSE DESCRIPTION (GRADUATE ESE COURSES)

ESE 802 Principles of Water Treatment Systems - An intensive study of the fundamental principles that are of import to water and wastewater treatment systems. Topics discussed include the principles of biological and chemical reactions, mass and heat transfer, reactor kinetics, adsorption and ion exchange, ESE 802 (Cont'd) - clarification and thickening, transient response analysis and control theory, and methods of operations research. (4 s.h.)

ESE 803 Laboratory Principles of Water Treatment - Demonstrations and selected laboratory exercises which illustrate the fundamental principles of water and wastewater treatment systems. Typical topics include respirometer studies, reactor systems, dispersion, gas transfer, adsorption, thickening, and control systems. Emphasis on the relation between theory and experimental results. (1 s.h.)

ESE 804 Design and Operation of Water Treatment Systems - An investigation of the design and operational criteria that are significant to the processes employed for the treatment of water and wastewater. Topics include coagulation and flocculation, filtration, adsorption and ion exchange, membrane separations, chemical precipitation and water stabilization, chemical oxidation and disinfection, activated sludge, fixed film biological reactors, anaerobic digestion, solids handling and disposal, and municipal and industrial economics. (4 s.h.)

ESE 805 Laboratory in Design and Operation of Water Treatment Systems - Laboratory exercises in selected water and wastewater treatment processes. Coagulation, flocculation, filtration, reverse osmosis, softening, activated sludge, anaerobic digestion, and sludge handling and disposal are typical topics studied. Emphasis on the operation of these processes and on securing suitable design parameters. (1 s.h.)

ESE 806 Integrated Problems in Water Treatment Systems - Integration of the processes involved in water and wastewater treatment into complex systems. Emphasis on functional design and operation through consideration of process economics and plant control systems. The design and analysis of several integrated water treatment systems. (2 s.h.)

ESE 831 Air Quality Monitoring - Principles of ambient and source measurements or air pollutants. Siting of air pollution monitors. Laboratory exercises in source testing and ambient air analysis. (3 s.h.)

ESE 832 Air Pollution Meteorology - Applications of meteorology to air pollution. Topics include micrometeorology, plume rise modeling, atmospheric diffusion, deposition and washout of pollutants, air chemistry and applications of diffusion modeling to air quality planning. (3 s.h.)

ESE 846 Pollution of Aquatic Environment - A study of the effect of pollution resulting from domestic and industrial wastes upon the physical, chemical, and biological characteristics of natural waters. (3 s.h.)

ESE 847 Pollution of the Aquatic Environment Laboratory - Field and laboratory investigations into physical, chemical, and biological effects resulting from pollution of the aquatic environment. (1 s.h.)

ESE 848 Environmental Engineering Chemistry II - Applications of the principles of organic and biochemistry to the problems of environmental control, waste treatment, and bioengineering. (2 s.h.)

ESE 849 Environmental Engineering Chemistry Laboratory II - Theory and application of instrumental methods of analysis as applied to measurements for environmental control. Spectroscopy and spectrophotometric techniques, electrochemical analyses, chromatographic methods of analysis, and light scattering and electrophoretic measurements are discussed in detail and demonstrated in the laboratory. Demonstrations and selected experiments in interfacing and analytical instruments with the small digital computer are conducted. (2 s.h.)

ESE 860 · Ecological Models - Systems analysis applied to ecology. Construction of models which predict ecological consequences of abuses to the environment. Frequency response analysis, energy models information flow, a transfer of functions for population interactions. (3 s.h.)

ESE 861 Environmental Systems Engineering Seminar - A discussion of current advances and research developments in various areas of environmental engineering. Off-campus speakers, students, and faculty participate. (1 s.h.)

ESE 862 Environmental Quality Case Study - An in-depth analysis and investigation of a significant current or recent situation affecting or involving some facet of environmental quality. The study is conducted by a team of students and results in a comprehensive position paper which integrates the pertinent social, political, and economic considerations in the case with the technical aspects. (1 s.h.)

ESE 881 Special Problems - Problems are selected in the field of environmental engineering to meet the interests and experience of student and instructor. (1-4 s.h.)

ESE 883,884 Selected Topics in Environmental Engineering - A comprehensive study of a topic in the field of environmental engineering that is not covered in another course. Topics covered vary to keep pace with current developments. (1-4 s.h.)

ESE 891 Research - Credit arranged.

ESE 991 Doctoral Research - Credit arranged.

INSTITUTION: CLEMSON UNIVERSITY

PROGRAM: Natural Systems

DEPARTMENT: Environmental Systems Engineering (ESE)

DEGREE: Master of Science (M.S.)
Master of Engineering (M.Engr.)

CONTACT: Dr. Thomas M. Keinath, Professor and Head
Environmental Systems Engineering
Clemson University
Clemson, South Carolina 29631
(803) 656-3276

PROGRAM DESCRIPTION:

PROGRAM STRUCTURE

The Department of Environmental Systems Engineering at Clemson University grew out of a group of faculty members formerly housed within the Department of Civil Engineering. The mission of this group was to provide graduate level education of environmental engineering professionals in response to specific needs of the State of South Carolina. After four years, in 1966, a graduate program in Environmental Systems Engineering was formally established as a separate entity within the College of Engineering. In 1968, a formal ESE Department was established.

Originally, there were four areas of specialization within ESE: Water and Wastewater Treatment Systems, Natural Systems, Environmental Science, and Planning and Management. An Air Pollution specialization was added in 1976. The Environmental Sciences specialization was merged with Natural Systems in 1977.

At the master's level, the M.S. or the M.Engr. may be pursued within each area of specialization. The M.Engr. degree program is accredited by the Engineers' Council for Professional Development at the advanced level. A program of study for the Ph.D. is also offered, which provides more flexibility for specialization. Within these degree programs, emphasis is placed on applying the basic principles of the sciences and engineering to the design, operation, planning and management of man-made environmental control systems. These include water and wastewater treatment facilities, air pollution control devices, and the analysis and management of natural systems such as streams, estuaries, and impoundments, as well as the air environment. Those students choosing the Natural Systems specialization concentrate chiefly on the effects of pollutants on the aquatic environment. Course work provides the tools needed for predicting the fate of conservative and non-conservative pollutants discharged into bodies of water. Students may also select electives in such areas as radiochemistry, air pollution, and oceanography.

Since the formal organization of the ESE Department, it has attracted over two million dollars in external funding, including over one-half million dollars in training grant monies from federal and state agencies. Active research in natural systems/ environmental sciences includes dynamic modeling of natural aquatic systems, environmental impact assessment, stream and estuarine water quality surveys, development of automated instrumentation for environmental monitoring, tracking of toxicants in the environment, and development and application of automated analytical instrumentation for environmental monitoring. Students may become involved with research through special projects or as paid research assistants.

In addition to the direct education of graduate students and the conduct of research, the ESE faculty is of service to the state and region through several other means. Short-term training and re-training has been provided to citizens, governmental agencies, industries and consultants since ESE's inception in the form of workshops, conferences, seminars, and short schools. These have included the topics of coastal zone pollution management, air and water pollution control, industrial waste treatment, upgrading treatment using lagoons, stream surveys, water quality modeling, and impact statement preparation.

The faculty also participates in a wide variety of professional activities such as serving on relevant state and federal boards and commissions, assisting in the development of technical curricula and curriculum materials, presenting testimony before Congressional committees, participating in educational television and radio programs, authoring papers, and chairing national and international symposia. One faculty member has served as an expert advisor to the Environmental Protection Agency (EPA), and all faculty members are actively involved with professional environmental associations.

PROGRAM REQUIREMENTS

Admission to the ESE programs requires a bachelor's degree in engineering or a scientific discipline such as chemistry or biology. Non-engineers must have had prerequisite course work in mathematics through differential equations, one year each of chemistry and physics, and courses in computer programming, fluid mechanics, and general environmental engineering. Applicants for the M.Engr. degree program must have a B.S. degree in engineering from an ECPD accredited institution with at least a 3.0 cumulative grade point average on the last sixty semester hours to be eligible for acceptance. Engineers who have had at least two years of documentable professional engineering experience may be granted full admission provided they had an undergraduate grade point average of 2.5 or higher. All M.S. program applicants must have earned at least a 3.0 cumulative grade point average on the last sixty semester hours, and must have taken the Graduate Record Examinations with a score of at least 1000, for full admission. An engineering degree is not required for entrance into the M.S. program; applicants may be eligible with B.S. degrees in fields such as biology, physics, chemistry or mathematics, as long as prerequisite course requirements are met.

Thirty semester hours are required for the master's degrees. One calendar year is normally required for completion of these degrees, although working as teaching or research assistants can prolong the length of study. Each student selects a major advisor. An advisory committee, chosen by the department head, the major advisor, and the student, approves the student's graduate degree curriculum, supervises the graduate program, administers the final comprehensive examination, and initiates the recommendation for the awarding of the degree. The Graduate School requires that all M.S. programs include six semester hours of research if the thesis option is chosen. Most students take a two to three hour special problems course in lieu of the thesis. Of the remaining required hours, at least half must be selected from courses numbered 800 and above, for the M.S. degree. For the M.Engr., at least half of the required hours must be selected from courses numbered 700 and above. Students pursuing this degree must also complete a special project.

All ESE students take a core of courses specific to their area of specialization. The Natural Systems concentration requires that students take nine core courses, or twenty-two semester hours, which consist of the following: ESE 602, ESE 643, ESE 644, ESE 802, ESE 803, ESE 861, ESE 846, WRE 870, and WRE 875. Electives are chosen based upon individual career objectives. All core courses, as well as representative approved electives, are described below.

ESE master's candidates may select a minor area of concentration. These normally consist of at least six hours of credit in the chosen area.

The College of Engineering offers cooperative graduate programs with industry in which semesters of on-campus study are alternated with work assignments in industry. ESE students rarely participate in these programs, as they lengthen the term of study.

CURRENT FACULTY, STUDENTS, GRADUATES

The ESE Department consists of seven faculty members, all holding the Ph.D. degree, with teaching and research interests and responsibilities in diverse environmental fields. As faculty members' activities overlap into two or more of the areas of specialization, identifying the number of faculty for each area of specialization is not possible.

The current enrollment in the ESE Natural Systems area of concentration is six. The number of students enrolled in this program and in the department has remained relatively stable over the last five years. The number of graduates in the original Natural Systems concentration (before the merger) was four in 1976. The number of graduates with a concentration in Environmental Science during that year was one. Generally, ESE graduates with the M.S. degree are more likely to become employed by governmental agencies, while those with the M.Engr. are more likely to enter the private sector. Follow-up statistics on sixty-four ESE graduates of the years 1974 to 1977 have been assembled, which reveal that eight of the graduates became employed by industries, twelve by consulting firms, thirty-nine by governmental agencies (local, state and federal), and five continued their schooling for the Ph.D. These figures also include graduates with the Ph.D.

Approximately 95 percent of the ESE students receive financial assistance from a variety of sources, including research assistantships, teaching assistantships, and training grants. The department has had EPA training grants which have supported students in air and water quality.

PROGRAM PROJECTIONS

Although the department is close to reaching the maximum number of students it can accommodate with the space available, it is expected that within three years the overall enrollment will increase from the present average of forty to forty-five, to approximately sixty.

Program officials anticipate a shift of emphasis within the Natural Systems area of specialization. In anticipation of increasing skilled workforce requirements of the Toxic Substances Control Act of 1977, in both the private and public sectors, there will be an expanded emphasis on the study of the effect of pollutants on the natural environment.

COURSE DESCRIPTION

Core courses:

ESE 602 Water and Waste Treatment Systems - Study of the fundamental principles, rational design considerations, operational procedures of unit operations and processes, physiochemical and biological treatment techniques. Introduction to integrating unit operations and processes into treatment systems. (3 s.h.)

ESE 643 Environmental Engineering Chemistry I - Study of the fundamental principles of physical and analytical chemistry applicable in treating waters and wastewaters: chemical thermodynamics, chemical kinetics, acid-base equilibria, complex equilibria, electrochemistry. (2 s.h.)

ESE 644 Environmental Engineering Chemistry Laboratory I - Demonstration of principles discussed in ESE 443 and laboratory exercises in analytical methods used in water quality control. Wet-chemical analytical techniques include residue analysis, turbidity, color, alkalinity, acidity, pH, hardness, iron, manganese, dissolved oxygen, biochemical oxygen demand. Modern instrumental and electroanalytical techniques commonly incorporated in environmental water quality monitors. (2 s.h.)

ESE 802 Principles of Water Treatment Systems - Intensive study of fundamental principles of import to water and wastewater treatment systems. Topics include principles of biological and chemical reactions, mass and heat transfer, reactor kinetics, adsorption and ion exchange, clarification and thickening, transient response analysis and control theory, and methods of operations research. (4 s.h.)

ESE 803 Laboratory in Principles of Water Treatment - Demonstrations and selected laboratory exercises to illustrate fundamental principles of water and wastewater treatment systems. Respirometer studies, reactor systems, dispersion, gas transfer, adsorption, thickening, control systems. (1 s.h.)

ESE 846 Pollution of Aquatic Environment - Study of the effect of pollution resulting from domestic and industrial wastes upon the physical, chemical, and biological characteristics of natural waters. (3 s.h.)

ESE 861 Environmental Systems Engineering Seminar - Discussion of current advances and research developments in various areas of environmental engineering. (1 s.h.)

WRE 870 Stream and Estuarine Analysis - Physical, chemical and biological processes and relationships which exist in streams and estuaries; estuarine environment, free-flowing streams, mechanisms which describe transport of conservative and non-conservative materials through estuarine systems; estuary as a resource and techniques for its management. (3 s.h.)

WRE 875 Water Resources Planning - Water resources planning emphasizing river basin and regional aspects; purposes and objectives of water resources development, historical review of water resources development in the U.S., changing emphasis over time, current practice and guidelines as well as new approaches and techniques, public and private sector involvement in water resources planning and development, formulation of alternative plans and their analysis, public participation and resolution of conflicts, institutional and social dimensions of water resources planning and plan implementation, water quality and water quantity and their interactions. (3 s.h.)

Selected Approved Electives:

ESE 849 Environmental Engineering Chemistry Laboratory II - Theory and applications of instrumental methods of analysis as applied to measurements for environmental control. Spectroscopy and spectrophotometric techniques, electrochemical analyses, chromatographic methods of analysis, light scattering and electrophoretic measurements. Demonstrations and experiments in interfacing analytical instruments with small digital computer. (2 s.h.)

CH 691 Introduction to Radiochemistry - Study of natural and synthetic isotopes, including atomic and nuclear structures, properties of radiation, tracer techniques and applications. Laboratory includes methods of detection and measurement of radiation and applications of tracer methods. (3 s.h.)

CHE 462 Air Resources Engineering - Basic study of important aspects of control and utilization of air environment. Air pollution sources and effects, monitoring procedures, dispersion models, engineering controls, economics of control. Legislation and enforcement principles. (3 s.h.)

WRE 660 Physical Oceanography - Integrated treatment of the fluid dynamic, ecologic, geologic, and resource aspects of physical oceanography. Basic principles of physical aspects of oceans with techniques for application. Emphasis on relating oceanographic phenomena to relevant problems. (3 s.h.)

WRE 865 Hydrology I - Hydrologic cycle as hydrologic system; deterministic hydrology; all aspects of physical hydrology emphasizing balanced approach to ground water hydrology and surface water hydrology; meteorology, infiltration, soil moisture, and evapotranspiration; probability analysis and partial system synthesis by unit hydrograph techniques. (3 s.h.)

WRE 872 Marine Pollution Control - Current technology and problems related to water quality management in the marine environment; coastal and estuarine problems; submarine outfall systems, disposal of dredged material and wastewater sludges, thermal and oil pollution, water quality instrumentation, monitoring, and surveillance in the marine environment, design of oceanographic surveys required for water quality control. (2 s.h.)

WRE 876 Water Resources Systems - Water resources systems area; application of current operations research and systems engineering techniques and their use in analysis, evaluation, design, operation and management of water resources systems; water quality systems, hydrologic systems, integrated multipurpose systems including reservoirs, regional environmental control systems, power-generating facilities, industrial water supply and pollution abatement systems. (3 s.h.)

INSTITUTION: CORNELL UNIVERSITY

PROGRAM: Environmental Engineering

DEPARTMENT: Environmental Engineering

DEGREE:
Bachelor of Science (B.S.)
Master of Science (M.S.)
Master of Engineering (Civil) (M.Eng.) (Civil)
Doctor of Philosophy (Ph.D.)

CONTACT:
Dr. Charles Gates
Department of Environmental Engineering
Cornell University
Ithaca, New York 14852
(607) 256-3658

PROGRAM DESCRIPTION:

PROGRAM STRUCTURE

Environmental engineering is a major program of the School of Civil and Environmental Engineering and offers both undergraduate and graduate degrees. At the graduate level, a student may concentrate in one of five areas: environmental quality engineering, fluid mechanics and hydrology, public and environmental systems engineering, transportation, and water resources planning and analysis (Ph.D. only).

The current program grew out of a sanitary engineering program which began in the early twentieth century. It is now interdisciplinary in nature and several faculty members hold joint appointments within the Department of Environmental Engineering and various other departments in the university. Degree programs are flexible and allow students to pursue subjects relating to their interests.

Several support facilities are available in conjunction with the program. These include special laboratories in sanitary engineering, hydraulics and hydrology, and transportation, as well as computer terminals and computerized data resources. In addition, an interdisciplinary research center cooperates with the Department of Environmental Engineering: the Center for Environmental Research.

PROGRAM REQUIREMENTS

Admission to the B.S. program requires a high school diploma with at least sixteen units (one unit is equivalent to one year of study) of college preparatory subjects. These must include four units of math, one of physics, and one of chemistry. The remaining units are normally in English, foreign language, history, social science, and natural or life sciences. Prospective candidates are requiredto take either the Scholastic Aptitude Test with achievement tests in math and physics or chemistry or the American College Testing program.

For entry into the M.Eng. program a student must have a baccalaureate degree from an accredited engineering program or its equivalent in an appropriate area of engineering or science. Cornell graduates must have a cumulative grade point average of 2.5/4 or petition for entry if average is lower. Graduates of other schools must provide evidence of undergraduate preparation equivalent to Cornell's, two letters of recommendation and a statement of academic purpose.

Requirements for admission to the M.S. and Ph.D. programs stipulate that applicants must hold a baccalaureate or equivalent degree from a college or university of recognized standing.

The undergraduate degree program is designed to provide a student with an introduction to civil and environmental engineering technology and the opportunity for liberal study. A minimum of one-hundred and twenty-six credits are required for the degree. The first two years are spent in a Basic Studies Program which includes the requirement that two engineering core science courses be taken in each term of the sophomore year. Mechanics of Solids is required as one of the courses and it is recommended that Introductory Engineering Probability and either Dynamics or Mechanical Properties of Materials be taken as two of the remaining core courses. Students with special interests can depart from the third and fourth year curriculum and develop their own program in consultation with a faculty advisor.

The M.Eng. program is one year in length and is designed to prepare students for careers as professional engineers. A minimum of thirty credit hours of graduate level work are required along with an engineering design project and a formal report on the project. Four specific courses are required, two in Professional Practice in Engineering, and two in Civil and Environmental Engineering Design Project. The remainder of the program is designed by the student in consultation with an academic advisor.

Both the M.S. and Ph.D. degrees require work in major and minor areas of concentration, such as the five areas mentioned previously. These degrees also require a thesis on research conducted under the direction of a faculty member. The M.S. and Ph.D. programs are designed for students seeking careers in academic or research work.

CURRENT FACULTY, STUDENTS, GRADUATES

Currently there are four faculty members assigned to the program, each of whom teaches about one-half time and conducts research about half time. Research funding for the program has come from various sources including the National Science Foundation, the Office of Water Research and Technology (Department of the Interior), the New York State Energy Office, The Ford Foundation, and EPA.

Fifteen full-time students are enrolled in the undergraduate program and eighteen full-time are in the graduate programs. It is estimated that about half of the students come from the east coast area even though no data is kept on in-state/out-of-state students. Recruitment by the program is informal and accomplished primarily through faculty contacts with other schools and advertising via announcements and brochures. Most students are receiving some form of financial assistance, especially at the graduate level. Sources include EPA training grants, teaching and research assistantships, and engineering scholarship funds. There are approximately fifteen bachelor's degrees awarded each year and an equal number of gradaute degrees. These figures are down slightly from the number of graduates in previous years. Officials estimate that about seventy-five percent of the B.S. graduates go on to graduate school while only about ten percent of Master's degree candidates continue their education. Most of the B.S. graduates, about eighty percent, find employment in private industry or consulting firms and approximately seventy-five percent of the graduate students work in the private sector. A large part of the remaining graduates find positions in the government. Generally, students are placed in positions through faculty contacts and through the university and College of Engineering placement services.

PROGRAM PROJECTIONS

It is anticipated that program levels will remain stable with no increase in students or faculty forseen.

ADDITIONAL INFORMATION

Program officials conduct a one week summer educational seminar on industrial waste engineering, primarily for industry officials. Another seminar, on solid waste management, is being planned for industry and regulatory agencies.

COURSE DESCRIPTION

(the following is a partial listing of courses)

IIE 301 Environmental Quality Engineering - Introduction to air, water, and solid waste aspects of environmental quality envineering with emphasis on water quality concepts, theory, and methodology. (3 s.h.)

IIE 602 Water-Quality Control - Biological, chemical and physical fundamentals underlying water and wastewater treatment and their application of the analysis and design of processes for the treatment of natural waters and of wastewaters. (3 s.h.)

IIE 610 Chemistry of Water and Wastewater - Principles of physical, organic, inorganic, and biochemistry applicable to the understanding, design, and control of water and wastewater treatment. (3 s.h.)

IIE 620 Environmental Quality Control - Environmental pollution problems: their nature, causes, and effects. Concepts, phenomena, and methodology fundamental to protection of the air-land-water environment. (3 s.h.)

IIE 630 Solid Waste Management - Study of municipal, industrial, and agricultural solid wastes. Emphasis on waste characteristics, methods of treatment and disposal, and interrelationships with air, water, and land environment. (3 s.h.)

IIE 631 Industrial Waste Engineering - Characterization of liquid gaseous, and solid industrial wastes; their effects on receiving media. Treatment and disposal alternatives. Legislative and regulatory aspects of industrial waste control; industrial effluent guidelines and limitations. (3 s.h.)

IIE 633 Environmental Quality - An introduction to environmental quality and pollution problems: their nature, causes and control. (3 s.h.)

IIE 634 Air Quality Control - An introduction to air quality and air pollution porblems. Sources, natures, and effects of specific air pollutants; their dispersion and interactions in the atmosphere. (3 s.h.)

IIE 791 Design Project in Sanitary Engineering - The student will elect or be assigned problems in the design of water and wastewater treatment processes or plants; wastewater disposal systems; water quality control systems; water resource development or management systems. (variable s.h.)

IIC 609 Descriptive Hydrology - Introduction to hydrology as description of the hydrologic cycle and the role of water in the natural environment. (2 s.h.)

IIC 620 Analytical Hydrology - Physical and statistical analysis related to hydrologic processes. (3 s.h.)

IIB 619 Environmental Systems Analysis - Application of systems analysis, environmental engineering, and economics to environmental quality management systems. (3 s.h.)

IIB 747 Environmental Policy Analysis - Current research topics concerning the application of economic and simulation techniques to the definition and evaluation of public policy alternatives for managing air, land, and water resources and the material and energy wastes released into the environment. (3 s.h.) (3 s.h.)

IIH 615 Water Resources Problems and Policies - A comprehensive approach to water resources planning and development. (3 s.h.)

IIH 718 Water Resources Systems - Application of economics, engineering, and mathematical optimization and simulation models to river basin planning and regional development, hydropower and irrigation planning, reservoir operation, flow augmentation for quality control, watershed runoff, and other multiobjective, multipurpose water resources planning and management problems. (3 s.h.)

INSTITUTION: CORNELL UNIVERSITY

PROGRAM: Waste Management Engineering

DEPARTMENT: College of Agriculture and Life Sciences

DEGREE: Master of Science (M.S.)
Master of Engineering (M. Eng.)
Master of Professional Studies (M.P.S.)
Doctor of Philosophy (Ph.D.)

CONTACT: Dr. Raymond C. Loehr
Director, Environmental Studies Program
New York State College of Agriculture
and Life Sciences
Cornell University
Ithaca, New York 14853
(607) 256-2008

PROGRAM DESCRIPTION:

PROGRAM STRUCTURE

Waste Management Engineering began in 1969 with initial emphasis on animal waste management. This has expanded to now include agricultural waste management, rural environmental engineering, nonpoint source pollution control, and land application of wastes.

This program is based in the College of Agriculture and Life Sciences. Four degrees are awarded, including the M. Eng. and M.P.S. which are professional degrees, emphasizing advanced work and project development. The M.S. and Ph.D. degrees however, emphasize original research and presentation of a thesis.

Facilities used in support of the program include several waste management laboratories, a pilot plant, large scale university and field facilities and the central computing system of the university.

PROGRAM REQUIREMENTS

Admission to the M. Eng. program requires that a student have a bachelor's degree from an accredited engineering program or its equivalent in an appropriate area of engineering or science. The M.S., M.P.S. and Ph.D. programs require applicants to hold baccalaureate or equivalent degrees from a college or university of recognized standing.

Requirements for the M. Eng. and M.P.S. degrees include thirty credit hours of graduate course work, of which six hours must consist of an engineering design experience involving individual effort and a formal report. No thesis is required. Program flexibility allows students to take courses of interest in a variety of subjects related to environmental and agricultural engineering.

The M.S. and Ph.D. programs are both extremely flexible in course requirements, allowing the individual student to choose his/her Special Committee, a faculty group which becomes solely responsible for his curriculum and research program. Original research and a thesis are required for either degree; M.S. students must take waste management as their major subject and select one minor subject from outside this area of specialization. The Ph.D. requires one major area of specialization and two minors, at least one of which must be in an engineering, agricultural, or basic science subject outside the field of specialization.

CURRENT FACULTY, STUDENTS, GRADUATES

The program faculty consists of four full-time and six part-time members, all of whom spend approximately one-half time teaching and one-half time in research. The program is the recipient of several sources of research funding, including EPA, the federal Departments of Energy and Interior, the National Science Foundation, the Rockefeller Foundation, and local farmer co-ops.

A total of eight full-time students are currently in the program, most of whom are from out of state. Students are recruited through faculty contacts at other institutions, brochures, and ads in professional journals. Most students are receiving some form of financial assistance, primarily research assistantships. Officials indicated that until three years ago, 80 percent of the students were supported by training grants and over a dozen full-time students were in the program.

An average of six students per year graduate from the program and this number is expected to remain constant. Only a small percentage of graduates continue on in school. Most graduates go directly into the workforce and have little difficulty finding jobs in their field, both in the public and private sectors. Generally, students are referred to jobs through faculty contacts.

PROGRAM PROJECTIONS

The program is not expected to increase in the near future. Capabilities exist for expansion, but officials indicated that increased financial support for students would be needed for expansion.

ADDITIONAL INFORMATION

Program officials conduct an annual waste management conference for officials of industry and government, and have developed a modular learning program in Land Application of Wastes to be offered in 1978.

COURSE DESCRIPTION (SELECTED)

471 Soil and Water Engineering - The application of engineering principles to problems of soil and water management. Design and construction of drainage, irrigation and erosion control systems, small reservoirs, and earth embankments. (3 s.h.)

475 Systems Models for Environmental Quality - Introduction to systems analysis techniques and their application to environmental quality management. (3 s.h.)

482 Environmental Control for Animals and Plants - Study of thermal interchanges between animals, including man, and plants with the environment. Understanding of physiological principles affecting thermal comfort and health. (3 s.h.)

675 Solid Waste Management - Study of municipal, industrial, and agricultural solid wastes. Emphasis on waste characteristics, method of treatment and disposal, and interrelationship with air, water, and land environment. (3 s.h.)

676 Industrial Waste Management - Legal aspects, assimilatory capacity of receiving water, joint industrial-municipal collection of wastes, and sewerage service charges. (3 s.h.)

677 Treatment and Disposal of Agricultural Wastes - Emphasis is on the causes of agricultural waste problems and on the fundamentals and application of possible treatment and disposal practices to control the problems. The course is aimed at having the students understand how to make decisions about selecting and utilizing appropriate agricultural waste management processes and systems, as well as how to design and operate the systems. (3 s.h.)

678 Environmental Quality Management for Agro-Ecosystems - The application of systems analysis and mathematics ecology to problems in ecosystem management and environment quality. (3 s.h.)

679 Use of Land for Waste Treatment and Disposal - The socio-legal-technical factors that dictate that disposal of wastes on land be a major alternative in all waste management schemes. (3 s.h.)

771 Soils and Water Engineering Seminar - Study and discussion of the management of agricultural waste, with emphasis on the physical, chemical, biological, economic, and aesthetic requirements. (1-3 s.h.)

INSTITUTION: DELAWARE TECHNICAL AND COMMUNITY COLLEGE

PROGRAM: Environmental Engineering Technology

DEPARTMENT: Applied Science

DEGREE: Associate of Applied Science

CONTACT: James T. Lober
Chairman of Applied Science Department
Delaware Technical and Community College
Stanton Campus
Rte. 7 and Churchman's Road
Newark, Delaware 19702
(302) 368-6984

PROGRAM DESCRIPTION:

PROGRAM STRUCTURE

First initiated in 1971, the Environmental Engineering Technology program prepares "Environmental Control Technicians" in the application of engineering principles in the fields of air and water. Graduates are especially qualified to conduct sample collections, laboratory analysis, treatment facilities design and operation and research and development. Students participating in the program receive an in-depth study of the basic sciences and receive training in skills in mathematics, chemistry, microbiology, and physics.

PROGRAM REQUIREMENTS

Delaware Technical and Community College has an open-door admissions policy although it is required to accept only high school graduates and applicants at least 18 years of age. There are no course prerequisites in order to enter this program.

Students are required to complete six quarter periods totalling 115 quarter hours of credit in order to earn the Associate in Applied Science degree. Included in the curricula are courses in advanced reading and study skills, technical mathematics, chemistry, technical report writing, probability and statistics, English, economics, and physics.

Students are eligible to apply for a variety of financial aid programs to help assist them in defraying their college expenses. This aid includes the typical Federal (e.g., National Student Defense Loans); Board of Trustee Scholarships; and work-study grants.

CURRENT FACULTY, STUDENTS, GRADUATES

A total of four faculty members contribute to the offerings of the program's curriculum. The total include two part-time faculty and two full-time instructors.

There are currently (Spring, 1978) a total of forty students enrolled in the Environmental Engineering Technology program. Twenty are full-time and of these five are female students. Twenty students (14 full-time equivalent) are enrolled on a part-time basis and eight students are female. It is estimated that on the average, a total of ten students annually receive the A.A.S. degree over the past four years.

Most graduates continue taking classes offered in evening colleges while they are working. As part-time students they enroll at Widener College, the University of Delaware, Delaware State College, and the City College of New York. Program officials estimate that thirty percent of the graduates have found employment related directly to their training. Forty percent have found positions in a related field and less than one percent have found totally unrelated jobs. More than ninety-nine percent of the recent graduates have found private sector positions. Program officials consider the prospects for placement of graduates to continue to be very limited in the environmental field.

PROGRAM PROJECTIONS

Because of the lack of job opportunities over the past several years, the College is considering reducing the status of the program from a full degree program to an option attached to the Chemical Technology programs. No change in staffing of faculty is expected to result as this program is already structured in an interdisciplinary manner. College officials foresee increasingly poor opportunities in the environmental field at least at the A.A. Technician level.

COURSE DESCRIPTION

(the following is a partial listing of courses)

EV 141 Introduction to Environmental Engineering - Study of the major modes of environmental pollution. Technical, social, economics, political, and public health aspects of pollution problems and solutions are explored. (3 q.h.)

EV 143 Environmental Microbiology II - Specific areas of biology important in environmental control: soil, air, aquatic, domestic water and wastewater, food, milk, and industrial microbiology. (4 q.h.)

EV 243 Environmental Chemistry I - Study of physical and inorganic chemistry as specifically applied to the environmental field: color, taste, odor, coagulation, turbidity, solids, alkalinity, acidity, sulfates, chlorides, hardness, BOD, COD, etc. (5 q.h.)

EV 247 Industrial Waste Treatment - Study of various industries, their associated waste, and current treatment methods: food production, metal processing, chemical production, paper manufacturing, petroleum refining, etc. (3 q.h.)

EV 142 Environmental Microbiology I - Study of the biological organisms important in pollution control and public health: bacteria, fungi, algae, protozoa, etc. Laboratory includes microscopic inspection and identification, cultivation techniques, and standard analysis procedures. (4 q.h.)

EV 241 Environmental Control Process Design I - Study of the engineering principles and design criteria of basic air pollution control processes. Design of cyclone and impingement separators; spray chambers; cyclone, orifice, mechanical, venturi scrubbers; baghouses; electrical precipitators

EV 244 Environmental Chemistry II - Organic and biochemistry as specifically applied to the environmental field. Laboratory includes standard methods of analysis for greases, volatile acids, nitrogen forms, chlorine demand, phenols, COD, surfactants, etc. (5 q.h.)

EV 246 Community Air Pollution - Introduction to meteorology; sources, classes, and effects of atmospheric pollutants; prevention and control methods; laws, regulations, and standards. Laboratory includes basic monitoring instrumentation, sampling techniques, and data interpretation. (4 q.h.)

INSTITUTION: DELGADO COLLEGE

PROGRAM: Environmental Health Technology

DEPARTMENT: Environmental Health Technology

DEGREE: Certificate, Environmental Health;
Associate of Science (A.S.) in Environmental Health Technology

CONTACT: Dr. Sushil K. Gilotra
Chairman, Environmental Health Technology
Delgado College
New Orleans, Louisiana 70119
(504) 486-7393 x 305

PROGRAM DESCRIPTION:

PROGRAM STRUCTURE

The environmental health technology program at Delgado College was instituted in 1973. The major purpose for the establishment of this program was to provide practical knowledge of basic environmental health concepts, principles, methods, and techniques to state and local personnel. This program provides the graduates with the basic skills applicable to most areas of environmental concern.

In addition, the program provides continuing education for those persons already employed in the field.

Financial assistance, in limited amounts, is available to selected students in various forms.

PROGRAM REQUIREMENTS

The general environmental health curriculum is accomplished, usually, upon successful completion of a two-year course of study. In addition, students must spend the two summers (at the end of the first year and also at the end of the second year) involved in the environmental health practicum.

Requirements for conferral of the Associate of Science degree in environmental health technology include the following:

Course		Semester Hours
First Year:		
LAE 141/ 142	English	6
MAH 103/ 104	Mathematics	6

Course			Semester Hours
First Year (cont'd):			
SCC 103/ 104	Chemistry		4
SCB 101	Biology		3
EHT 101/ 102	Environmental Health		4
EHT 104	Industrial Hygiene		3
EHT 105	Food Service Hygiene		3
EHT 113	Water Purification		3
EHT 252	Vector and Rodent Management		3
		Total	35
Second Year:			
SSP 121	Psychology		3
SSS 151	Sociology		3
SCB	Approved Electives		3
EHT 207	Epidemiology		3
EHT 209	Microbiology		4
EHT 218	Environmental Monitoring		3
EHT 220	Air Pollution		3
EHT	Approved Electives		9
		Total	31

Therefore, in addition to the 66 semester hours of required course work, the student must also complete the environmental health practicum for six semester hours. The total semester hours reruired equal 72.

CURRENT FACULTY, STUDENTS, GRADUATES

Currently, the faculty allocated to the environmental health technology program includes three full-time teaching personnel. In addition, there are 10 part-time persons who assist with these programs.

The enrollment, at present, includes 41 full-time students. Of the 41 total, 28 are male and 13 are female. There are no current statistics available for part-time students. Graduates average approximately six annually.

PROGRAM PROJECTIONS

The environmental health technology program is anticipated, by the faculty, to illustrate growth over the next few years. In response to this growth in student population and in course offerings, one faculty member will be added to the staff during the next three to five years.

COURSE DESCRIPTIONS (selected)

EHT 101 Principles of Environmental Health - History, development, and philosophy of environmental science. Problems involving water

EHT 101 (cont'd) - supplies, sewage disposal, air pollution, solid wastes, swimming pools, industrial hygiene, occupational health, radiological health. (3 s.h.)

EHT 102 Institutional Environmental Health - Aspects of environmental health problems in instutions. Water supply, sewage disposal, and solid waste management. (1 s.h.)

EHT 103 Community and Institutional Health - Introduction to environmental and public health problems. (1 s.h.)

EHT 104 Industrial Hygiene - Recognition, evaluation, and control measures of problems associated with the hospital working environment. (3 s.h.)

EHT 110 Introduction to Radiological Monitoring and Civil Defense - Basic radiological monitoring information. (3 s.h.)

EHT 111 Solid Waste Management - Introduction to the fundamentals of solid waste characterization, handling, and disposal systems. (3 s.h.)

EHT 118 Environmental Monitoring I - Designed for environmental health, safety, and industrial personnel. (3 s.h.)

EHT 212 Radiological Health - Study of methods used in radiation detection, measurement, and handling of radioisotopes in the institutional and industrial environment. (3 s.h.)

EHT 220 Introduction to Air Pollution - The general field of air pollution. Emission, air pollution history, meteorology, atmospheric dispersions, effects on humans, and sampling and control equipment. (3 s.h.)

EHT 280 Industrial Environmental Health - Concepts and practices of industrial hygiene in sensing hazardous exposures and safeguarding the health of workers in industrial occupations. (3 s.h.)

EHT 105 Food Service Hygiene - Broad introduction to food sanitation, fundamentals of food protection and preservation, standards of quality, and sanitary requirements for production, processing, and distribution. (3 s.h.)

EHT 113 Water Purification - Basic principles of water purification. (3 s.h.)

EHT 114 Wastewater Treatment - Basic principles of elementary waste disposal by anaerobic and aerobic processes, quantities of waste flow, sampling and testing procedures. (3 s.h.)

EHT 130 Urban Environment - Non-technical course to discuss common and important facets of environmental health and how to improve life quality in urban areas. (1 s.h.)

EHT 150 Environmental Health Practicum I - Specific experience geared to career objective of student performed in a work and/or laboratory situation in environmental health under the guidance of a qualified environmentalist. (3 s.h.)

EHT 155 Pesticides and Spray Equipment - Course to familiarize students with chemicals and non-chemical agents to manage pests. Special emphasis is placed on the description and use of various spray equipment. (3 s.h.)

EHT 209 Public Health Microbiology - Microbiological testing, measuring, and evaluation systems used in food and milk hygiene, water quality, water pollution, and infection control. Prerequisite: Permission of department chairman. (4 s.h.)

EHT 250 Environmental Health Practicum II - Specific experience geared to career objective of student performed in a work and/or laboratory situation in environmental health under the guidance of a qualified environmentalist. (3 s.h.)

EHT 256 Impact of Urban Pests on Health - What and how diseases are transmitted by mosquitoes and other pests. Life cycles of disease agents and their control are discussed. (3 s.h.)

INSTITUTION: DREXEL UNIVERSITY

PROGRAM: Environmental Engineering and Science

DEPARTMENT: Multidisciplinary-Institute for Environmental Studies

DEGREE: Master of Science in Environmental Engineering
Master of Science in Environmental Science
Doctor of Philosophy

CONTACT: Dr. P.W. Purdom
Director of Environmental Engineering and Science Program
Institute for Environmental Studies
Drexel University
Philadelphia, Pennsylvania 19104
(215) 895-2265

PROGRAM DESCRIPTION:

PROGRAM STRUCTURE

Initiated in 1963, the graduate program in Environmental Engineering and Science is offered by the Institute for Environmental Studies. A multidisciplinary program, the departments of physical sciences, engineering, and life and social sciences cooperate. The following areas of concentration are offered : Environmental Health; Environmental Planning and Management, Air Resources, Occupational Health; Water Quality and Resources; Solid Wastes; Environmental Assessment; and Environmental Chemistry. Other tracts of study may be developed where the preceding do not meet the student's needs.

Faculty and students utilize research facilities in various colleges for their work in environmental programs. The program's own laboratories include solid wastes, water and wastewater treatment, toxicology, environmental chemistry, and environmental rooms for the study of human behavior and reaction. Small incinerator studies using air flow equipment contained in a large incinerator room are conducted. An environmental library is located in Drexel's library and students have access to computer based abstract services (plotting facilities) and computer terminals. Much research is conducted in collaboration with government agencies and industries in the field. An example is a re-oxygenization study currently being conducted at a dam site in Georgia by a Drexel professor.

PROGRAM REQUIREMENTS

In order to enter this program a strong background in science and mathematics is necessary and applicants are requested to have at least two terms of college chemistry and differential and integral calculus. Students with this background are welcomed from all engineering fields, physical, life, and the social sciences.

The Master of Science in Environmental Engineering is awarded to students holding a Bachelor of Science degree from a curriculum accredited by the Engineer's Council for Professional Development. The Master of Science in Environmental Science is awarded to students possessing a Bachelor of Science degree. All Master's degree applicants complete 48 quarter-credits of course work and full-time students generally require 12 months to complete the program. All students also must complete a project or thesis of six to nine credits. Ph.D. students have a prepared individual course plan which is reviewed by a faculty committee which also administers a candidacy examination. After passing the candidacy examination, the student's research is supervised by a special faculty committee of at least five persons.

Most of the financial assistance provided to graduate students in the program consists of direct grants and fellowships. Drexel awards 15 traineeships supported by the U.S. Department of Health, Education and Welfare. The university supports one teaching assistantship and four to six students with research positions. One laboratory technician is hired by the program. The City of Philadelphia supports three students on a part-time basis.

Many part-time students receive tuition compensation from their employers in industry or government to attend night classes. Most industries in the area do not provide time off during the day to enable their employees to attend day classes so classes are rotated in the evenings.

CURRENT FACULTY, STUDENTS, GRADUATES

Thirty-seven faculty members participate in the teaching of the program's curriculum. Only ten to twenty percent of the staff do not participate in research activities and all faculty are required to teach. Faculty are involved in a broad range of basic and applied research in the following areas: Air Pollution and Air Resources; Water Quality and Water Resources; Solid Wastes; Ecology; Toxicology and Environmental Chemistry; and Environmental Management.

A total of 105 students are enrolled in the program during the fall quarter of 1977 and 69 are part-time(including Master's and Ph.D.). Fourteen students are conducting post-master's work and five passed their candidacy exams to begin work on their doctorates. Two female students are working on post-masters research; four to six are in the M.S. program and one is enrolled in the doctorate program.

During 1976, fifteen students earned the M.S. degree, twelve earned the M.S. in Environmental Science, and four received doctorates. Approximately ten percent of the program's graduates continue on for further education and less than ten percent of those continuing stay at Drexel University. One to two annually attend medical schools, a few go to Schools of Public Health (Michigan, Harvard, North Carolina Florida) and others go on to various universities, such as, Stanford and the University of Illinois for advanced degrees. Virtually all graduates obtain employment directly in their field and it is estimated that 60 percent obtain private sector jobs and 40 percent find government positions. Most Ph.D.s obtain positions conducting research for industry or private research firms and few with doctorates work for government agencies.

PROGRAM PROJECTIONS

Enrollment has remained stable, although a slight decline has been detected by program officials. Most part-time students are enrolled in water pollution courses. Solid waste courses are now offered every other year. These courses have not been developed as a full-time program. The air pollution specialty may have to be dropped as a specialty area if the number of students enrolled in this area does not increase.

Most faculty additions are expected to result mainly from replacing staff members who have left. Recently, a civil engineer was recruited with an air pollution control engineering background. Two other faculty will be replaced by a civil engineer with a water quality engineering background and, a toxicologist recruited by the Biological Sciences Department to teach biochemistry courses.

Expansion of the program depends on the needs of cities and industry for short course in-service training. If expansion does become necessary, it will probably be in the areas of toxic and hazardous substances which are big health problems. Thirty or more students are enrolled in the occupational health specialty area without training grants as they perceive this as an area requiring future trained specialists.

COURSE DESCRIPTION (SELECTED)

F 202 Environmental Chemistry - Principles of physical and organic chemistry applicable to the study and evaluation of environmental conditions, especially the pollution of air, water, and soil. (3 q.h.)

F 208 Fate of Pollutants in the Air and Water Environment - The physical and chemical mechanisms that define the fate of a pollutant are theoretically delineated and applied to model environmental systems. (3 q.h.)

F 209 Advanced Environmental Chemistry - Thermodynamic and kinetic principles and their application to the study of chemical changes and reactions in the water or air environments. (3 q.h.)

F 214 Environmental Physiology - Effects of air pollutants, water pollutants and general environmental factors such as heat, light, sound, stress and activity upon the functions of the human respiratory, nervous, blood and excretory systems. (3 q.h.)

F 221 Environmental Health - Evaluation of environmental hazards, design of environmental controls for the health and well-being of man. (3 q.h.)

F 222 Epidemiology - Principles, purposes and methods of epidemiology; application of methods for the investigation of problems in the field of human diseases, infectious and noninfectious, emphasizing the relationship and equilibrium of host and environmental factors. (3 q.h.)

F 239 Toxicology - Acute and chronic effects of toxic substances and residues. Environmental exposures and controls. (3 q.h.)

F 241 Air Pollution Control Processes - Detailed study of the design and operation of air pollution control processes: settling filtration, inertial separation, scrubbing and precipitation. (3 q.h.)

F 243 Air Pollution Sources - Sources of air pollution will be considered in depth. (3 q.h.)

F 244 Air Resource Management - Component parts of air pollution control programs: air pollution standards, background survey, elements of air pollution control laws, misdemeanor and injunctive surveys, socio-economic surveys, and operation of an air resource management program. (3 q.h.)

F 252 Water Quality Control Laboratory - Analytical procedures used in the assessment of water quality as applied to the analysis of natural waters and to the control of water and waste water treatment processes. (3 q.h.)

F 255 Stream Analysis and Pollution Control - Fundamentals of limnology. (3 q.h.)

F 270 Solid Wastes Systems - An analysis of the public health, economic and political aspects in the operation and design of storage, collection and disposal of solid waste materials. (3 q.h.)

F 279 Environmental Project Analysis - Candidates for the master's degree in Environmental Science, or Environmental Engineering, are required to select an appropriate problem, formulate an approach to its solution, and then test this solution in so far as it is practical. (3 q.h.)

F 291 Research Methods - Introduction to research methods and literature, procedures for the collection and analysis of data; preparation of technical papers. (3 q.h.)

F 298 Thesis - Each student working on a dissertation will file a written report each quarter with his supervisory committee. A copy of this report must be filed with the Program Graduate Student Advisor. (2-12 q.h./term)

INSTITUTION: DUKE UNIVERSITY

PROGRAM: Civil Engineering/Urban and Environmental Engineering

DEPARTMENT: Civil Engineering

DEGREE: Master of Science in Civil Engineering
Master of Science in Urban and Environmental Engineering
Doctor of Philosophy

CONTACT: Dr. P. Aarne Vesilind, Director of Environmental Center
School of Engineering
Duke University
Durham, North Carolina 27706
(919) 684-2434

PROGRAM DESCRIPTION:

PROGRAM STRUCTURE

Students pursuing the M.S. in civil engineering or the Ph.D. may specialize in any of the following areas: environmental engineering; geotechnical engineering and soil mechanics; mechanics of solids; materials engineering; fluid mechanics, water resources and ocean engineering; structural engineering; and urban systems and transportation. Also available are interdisciplinary programs combining study in some of the major areas with biological sciences, business administration, materials science, social sciences, political science, and other areas of engineering. Students may also select a special program leading to the M.S. in civil engineering and the A.M. degree in public policy sciences. The civil engineering degrees are accredited by the Engineers' Council for Professional Development.

A graduate option leading to the M.S. degree in urban and environmental engineering is also available through the Department of Civil Engineering. This option was created for non-engineers and for engineers with a non-civil engineering background who have a strong interest in the quantitative aspects of devising solutions to environmental problems.

A wide array of environmentally related research is carried out by faculty within the Civil Engineering Department. Areas of specialty include wastewater solids disposal, solid wastes, physical-chemical processes, urban systems, sanitary engineering design, engineering economics, unit processes, water resources, planning, water supplies, and water and wastewater drainage. Well-equipped laboratories are available to students for research projects, and thesis and dissertation preparatory work.

The Duke Environmental Center allows students and faculty in the various departments to expand upon research and learning activities in the environmental field. The purposes of the center are to focus attention on pressing environmental problems, to provide orientation and educational opportunities in environmental subjects, to promote interdisciplinary research, and to serve as a point of contact for the university, environmental agencies, and the public. The center sponsors a visiting speaker program, graduate and faculty seminars, and courses in environmental studies. The research efforts are aimed at the creation of multidisciplinary task forces in specific areas of environmental concern.

Engineering graduate programs are among the youngest at Duke University, but maintain very high student quality. In 1976, there were fifty-three applicants for every nine openings.

PROGRAM REQUIREMENTS

A minimum prerequisite to the graduate M.S. program in civil engineering is a basic knowledge of mathematics through linear differential equations, materials science, solid mechanics, and fluid mechanics. A grade point average of 2.7 on a scale of four is considered a guideline for admission to the program. The GRE is recommended, though not required. Admission to this program normally requires an undergraduate degree in civil engineering from an accredited institution.

Those with non-civil engineering backgrounds entering the urban and environmental engineering program must possess adequate undergraduate preparation. This includes: a minimum of four courses in mathematics, including two courses in differential and integral calculus, and two additional courses in mathematics, statistics, or an approved related area; a minimum of four courses in natural or physical sciences, of which at least two are in physics or chemistry; and a minimum of four social science/humanities courses, plus English I or the equivalent.

A minimum of thirty semester units of credit beyond the bachelor's degree is required for the M.S. degree in civil engineering. Twelve of these are in the major field, six in a related minor (usually mathematics or natural science), six in either the major or minor subject or in other areas approved by the department, and six for a research-based thesis. With departmental approval, students may take, in lieu of the preparation of a thesis, an additional six units of course work and a special project. Those choosing this option must take comprehensive examinations over their course work, and must orally defend their special projects.

The M.S. program in urban and environmental engineering is identical to the M.S. in civil engineering for those students with an engineering background. Students without an engineering degree are required to take two additional courses, which are usually designed to provide the necessary undergraduate background in urban and environmental engineering.

The Ph.D. degree requires at least sixty units of credit beyond the bachelor's degree. Twenty-four of these are required in the major field, twelve units in a related minor field, twelve in either the major or minor subject (or other approved areas), and twelve for a research-based dissertation. Doctoral students are required to pass qualifying and preliminary examinations, which are written, oral, or a combination of the two.

Students may receive credit for, as a portion of their minimum course work, courses offered by the Department of Environmental Sciences and Engineering of the University of North Carolina. While related course work is usually within the fields of mathematics or natural sciences, students may also elect courses in the social or managerial sciences if their interests lie within these fields.

Student financial support generally comes from two sources. The university's Graduate School hires a number of graduate students as research assistants, and research grants have provided support for many students.

CURRENT FACULTY, STUDENTS, GRADUATES

There are currently eleven full-time and four adjunct faculty members in the Department of Civil Engineering. Two full-time members and three adjuncts serve the environmental programs. All faculty members have both teaching and research responsibilities.

Twenty-six students are currently enrolled within the department. Of these, approximately one-half are in the environmental/urban and environmental engineering options. On a ten-year average, for the entire department, eight have received the M.S. degree annually, while four have received the Ph.D. each year.

While systematic student follow-up has not been carried out, department officials believe that every graduate has been successful at securing employment in his/her field. An estimated one-third of the graduates with the Ph.D. go into teaching, while the remainder enter research and consulting. It is also estimated that one-third of those earning the M.S. have become employed with governmental agencies, and two-thirds with private consulting firms. Few, if any of the graduates have continued their schooling.

PROGRAM PROJECTIONS

Program administrators foresee a need for expansion over the next five years; specifically, several new faculty members will be required. Additionally, discussion is underway regarding the possible development of a Cooperative College Program, allowing undergraduate students to begin the master's program in civil engineering following the junior year. Substantial additional funding would be required to carry out these forecasts, however, which is not available from the university budget.

It is particularly noteworthy that faculty in environmental engineering have recently developed a curriculum in resource recovery engineering. As reported in the October 1977 issue of the Journal of the Environmental Engineering Division, three new courses were developed: "Solid Waste and Resource Recovery Engineering", "Materials Design and Resource Conservation", and "Resource Recovery Systems Management".[1] The development of these courses was the result of the obvious need today for the development of trained and educated manpower in the area of reclaiming goods of marketable value from the waste stream. The faculty believes that resource recovery should become an integral part of many environmental engineering programs. The developed courses are abstracted below.

COURSE DESCRIPTION (Selected)

222 Open Channel Flow - Basic principles. Selected flow problems and practical solutions; gutter and inlet flows, flow over spillways, flow into estuaries and bays. Design of open channel structures, river hydraulics. Design of flood control and navigation structures; culverts, bridge openings, and energy dissipators. (3 s.h.)

224 Costal and Offshore Engineering - Basic analytical concepts; wave phenomena, theory of surface water wave motion, wave modification, and wave spectra. Effects of waves on structures emphasizing design of marine facilities. (3 s.h.)

225 Engineering Hydrology - Processes governing the origin, distribution, and depletion and replenishment of water resources, and application of this knowledge to the solution of water supply and drainage problems. (3 s.h.)

241 Environmental Engineering Chemistry and Biology - Inorganic and organic chemistry as applied to water and wastewater treatment. (3 s.h.)

247 Air Pollution Control - The problem of air pollution, with reference to chemical and biological effects. Measurement and meteorology of air pollution. Air pollution control methods, and law, noise pollution, and odor. (3 s.h.)

248 Solid Waste and Resource Recovery Engineering - Engineering design of resource recovery systems. Sanitary landfills and incineration of solid wastes. Energy recovery and recycling municipal refuse. Collection, treatment, and disposal of solid wastes from wastewater treatment. (3 s.h.)

249 Resource Recovery Systems Management - The social, economic, legal, political, and administrative aspects of resource recovery from municipal solid wastes. (3 s.h.)

---

[1] Aarne P. Vesilind, "Resource Recovery Engineering Curriculum", Journal of the Environmental Engineering Division (October 1977): 761.

INSTITUTION: EAST CENTRAL OKLAHOMA STATE UNIVERSITY

PROGRAM: Environmental Science

DEPARTMENT: Environmental Science (School of)

DEGREE: Bachelor of Science (B.S.) in Environmental Science

CONTACT: Dr. M.L. Rowe
Assistant Professor and
Chairman of the Department
School of Environmental Science
East Central Oklahoma State University
Ada, Oklahoma 74820
(405) 332-8000

PROGRAM DESCRIPTION:

PROGRAM STRUCTURE

East Central Oklahoma State University instituted the Bachelor of Science degree program in environmental science in 1969. The program has undergone several revisions since the date of inception, and today is approved by the Accreditation Council of the National Environmental Health Association. At present, less than 25 colleges and universities are accredited by this association.

Program emphasis is directed at producing a graduate with broad-based training in environmental problems and solutions. The graduate of this program is a generalist, and thus, is able to pursue problems which may encompass a variety of pollution control and abatement issues.

The program faculty encourages students to conduct individual research projects, participate in appropriate field trip activities, and attend and participate in seminars and workshops especially as they relate to current developments, problems, and solutions.

A substantial number of research activities are presently being conducted through the School of Environmental Science. Selected students are invited to participate in these research projects. On-going studies are being conducted primarily in the inter-related areas of water and wastewater.

Historically, program graduates have found few obstacles to obtaining employment in occupations which span most of the environmental control areas such as water, wastewater and radiation. Graduates are qualified to enter occupations such as: air pollution monitor; solid waste systems manager; radiological health specialist; water/wastewater treatment plant technician; sanitarian; and, safety and sanitary inspector.

PROGRAM REQUIREMENTS

There are no special requirements for acceptance by the School of Environmental Science other than the satisfaction of university admission requirements and procedures. Most students enter the program at the beginning of the junior year. Approximately 35% of the entering students are transfers from Oklahoma junior colleges. East Central Oklahoma State University students are encouraged, however, to indicate environmental science as their major as early as the freshman year. Through early identification, students are advised to complete ES 1113 and ES 1213 prior to entering the program at the junior level. In the event that these two courses were not part of the student's lower division studies, they must be integrated into the upper division requirements.

Degree requirements include completion of a minimum of 124 semester hours of course work, at least 30% of which is in residence (on campus).

Having completed the appropriate lower division course work, as well as ES 1113 and ES 1213, the student enters the junior year with the following requirements for degree candidacy: (a) 11 semester hours of core courses (ES 3013, 3303, 3503, and 3102); (b) 21 semester hours chosen from the three orientation areas of health, (ES 3113, 3153, 4113, 4143, 4203, 4253, and 4994), environmental control (ES 3553, 3602, 4553, 4603, 4653, and 4994), and human ecology (ES 4353, 4403, 4453, and 4994); and, (c) 18 semester hours of an approved minor. The student must select at least 6 credit hours from the health orientation. Where 24 semester hours of biology, chemistry and physics have been completed the student is required to take only 16 semester hours in an orientation.

CURRENT FACULTY, STUDENTS, GRADUATES

Current faculty includes three full-time, cost-centered personnel. Teaching responsibilities are allocated as follows: one full-time environmental sciences, plus occasional chemistry; one half-time environmental health and half-time physics; and, one half-time environmental health and half-time biology.

Enrollment at present, totals 64 students. Of the 64 total, there are 47 male and 10 female full-time students, and seven part-time male students. In addition, there are four students from outside the School who have elected environmental science as a declared minor.

The number of graduates remained stable from 1972 through 1976 with 11 to 13 graduating annually. In 1977 the graduating students increased to 18. Most of the students choose a career path upon graduation. Appro imately 18%, however, elect to pursue advanced degrees at institutions such as the University of Oklahoma and Oklahoma State University. Traditionally, the graduates of this program gain entrance to the chosen graduate programs. Those students entering the world of work at this level, are considered to be highly employable. The faculty is unaware of any graduate who was not successful in obtaining employment upon completion of the Bachelor of Science degree program.

PROGRAM PROJECTIONS

The faculty anticipates an approximate 5% per annum growth rate in the environmental science program. In response to this expansion and in an effort to increase the number of evening course offerings, the following personnel will be added to the current faculty, possibly by June 1978: one doctoral student in environmental health administration; one master's level state health sanitarian; and, one Ph.D. consultant from the U.S. Environmental Protection Lab at Ada. These three additional part-time faculty members will help to alleviate the evening teaching responsibilities of the regular faculty.

Students and graduates of this program have been increasing, on the average, over the last five years. Since the faculty has achieved the reputation of excellence for this program, every indication expresses growth and expansion. The approval by the Accreditation Council of the National Environmental Health Association has served to document the reputation of quality and excellence.

COURSE DESCRIPTION:

Core Courses:

Env Sci 3031 Introduction to Environmental Science - An overview of man and his environment is presented. The quality of water, air and food required by man and the removal of wastes from the environment are presented. (3 s.h.)

Env Sci 3303 Human Ecology - This course is an examination of the social aspects of man in a man-centered ecological system. Topics included are those of population, human culture differences and their varying effects on nature and institutions for environmental control (3 s.h.)

Env Sci 3503 Environmental Control - A survey of the various techniques which can be utilized in the management of the environment. (3 s.h.)

Env Sci 3102 Environmental Health Survey and Statistical Techniques - This course consists of classwork and a field experience. One hour each week during the semester is spent learning the rudiments of statistical analysis and in the planning of an environmental survey of a community. During the two week period immediately following the semester, the students will conduct the survey in a community in southern Oklahoma and analyze the results. (2 s.h.)

Env Sci 3113 Epidemiology (Health Orientation course) - A study of the etiology and characteristics of the principal diseases of man and the control of infected individuals and environment. Methods of presenting and interpreting epidemicity and endomicity are presented. (2 s.h.)

Health Orientation courses:

Env Sci 3153 Environmental Health Administration - The structure and administration of environmental health organization are covered. The legal and financial basis of programs and the management practices utilized in present programs are discussed. (3 s.h.)

Env Sci 4133 Institutional and Occupational Health - Recognition, evaluation and control measures of variable affecting the environmental health aspects of work habitats, schools, camps, hospitals, nursing homes, day care centers and other public facilities are presented. (3 s.h.)

Env Sci 4203 Community Sanitation - A lecture and laboratory study is made of the environmental functions performed by personnel in a typical city-county health department. Topics are discussed in the course including food and milk protection, swimming pool sanitation, measures for the abatement and control of pests, percolation tests for septic systems, sanitary surveys and health program aspects of air, water and solid wastes. (3 s.h.)

Environmental Control Orientation courses:

Env Sci 3553 Water Science - An integrative study of the occurrence properties, distribution and utilization of water in natural and man-made systems. (3 s.h.)

Env Sci 4553 Water Quality Surveillance - A preliminary study of water quality control in which the measurements and study of the biological and chemical factors affecting the aquatic environments are stressed. The processes used to treat water and wastewater are surveyed. Laboratory experience is also stressed. (3 s.h.)

Env Sci 3603 The Atmosphere and its Pollutants - This course is a study of both atmospheric phenomena affecting air pollutant responses and the characteristics of the common air pollutants. (2 s.h.)

Env Sci 4603 Air Pollution Control Processes - A study of the unit processes utilized in the cleaning of gaseous mixtures. Sampling and measurement techniques are presented. Laboratory experiences are stressed. (3 s.h.)

Env Sci 4653 Qualitative Aspects of the Urban Environment - The community environment is examined from the standpoint of sanitation and aesthetics. Solid waste, drainage, open space planning, noise suppression and community maintenance activities are also discussed. (3 s.h.)

INSTITUTION: EAST TENNESSEE STATE UNIVERSITY (ETSU)

PROGRAM: Environmental Health

DEPARTMENT: Environmental Health

DEGREE: Bachelor of Science in Environmental Health (B.S.E.H.)

CONTACT: Dr. Monroe T. Morgan, Chairman
Department of Environmental Health
East Tennessee State University
Johnson City, Tennessee 37601
(615) 929-4268

PROGRAM DESCRIPTION:

PROGRAM STRUCTURE

This was the first B.S.E.H. to be accredited by the National Accreditation Council of the National Environmental Health Association and has since set the criteria for like accreditations elsewhere. Hunter College in New York and Colorado State University both modeled their curricula after ETSU's.

The environment is an ecosystem, none of the parts of which are able to function entirely unto themselves. Traditionally, people have been trained to work in one specific aspect of environmental maintenance, but very few were able to coordinate and choreograph the interaction of these separate activities to cooperate with the natural overlap which occurs in ecosystems. Graduates of this program are prepared to work in that precise area, the interface. These people are fit environmental program coordinators, environmental planners, environmental impact analysts, human ecologists, public health officers, environmental health administrators, consumer safety specialists, industrial hygienists, epidemiologists, milk and food technologists, water supply developers, environmental health instructors, accident prevention specialists and, as per tradition, sanitarians.

The generalist program was begun in 1966 and, while training will still be bent in the interface direction, additional needs have been recognized. Shortly, students will be able to decide between the traditional generalist curriculum or a specialist curriculum in air, water, solid waste, or industrial hygiene.

PROGRAM REQUIREMENTS

Graduates of approved Tennessee high schools are eligible for admission to ETSU. Out-of-state students must have appropriate college preparatory backgrounds, be in the top half of their graduating class, and, like in-state applicants, submit either American College Testing Program scores of Scholastic Aptitude Test scores. Applicants eighteen years of age or older, who are not graduates of an approved high school, may qualify for admission on the basis of an average score of forty-five on the General Educational Development Tests (GED) or on presentation of a GED diploma.

The university requires a core of fifty-seven quarter hours of general liberal arts courses such as English, speech, economics, psychology, sociology, art history, music, and others. This major calls for forty-one hours of math and sciences; specifically, eight hours of general biology, eight hours of chemistry, four hours of anatomy, four hours of physiology, four hours of physics, and nine hours of mathematics. Students may select twenty-six hours of courses in free electives.

Sixty-six hours of courses in the College of Health are needed for the major, these are: Personal Health, Introduction to Environmental Health, Principles of Epidemiology, Water Supplies and Wastewater Treatment, Environmental Control of Insects and Parasitism, Health Communications, Introduction to Air Pollution, Environmental Safety, Food Sanitation Principles, Solid Waste Management, Community Health, Environmental Health Aspects of Housing and Medical Care Facilities, Introduction to Radiological Health, Occupational Health, Introduction to Vital Statistics, Public Health Sanitation, Biological Foundations of Sanitation, Environmental Health Equipment, Environmental Analysis, and Environmental Health Program Planning. The entire program consists of one hundred and ninety-two quarter hours.

CURRENT FACULTY, STUDENTS, GRADUATES

Eight full-time people have charge of the Department of Environmental Health. There has been an administrative change in the university which has resulted in a campus-wide priority shift. This shift has placed increased emphasis on faculty persons having Ph.D.'s to facilitate research grant soliciting and also to enhance the staff expertise level in those departments offering or wishing to offer Ph.D.'s.

One hundred and forty-six undergraduate students are pursuing B.S.E.H. degrees. Fifty-nine percent of these students are Tennessee residents. Officials of this department hope that the enrollment is not permitted to expand much more than the present level.

During the academic year (AY) 1975-1976 there were sixty-three graduates of this program, and during AY 1976-1977 there were forty-seven. Even though there is a placement office on campus, its use is discouraged. Program sources say that the type of occupation which is usually listed there is for the traditional sanitarian. These graduates are qualified to perform that service, but the unique nature of their training has provided them with a level of skill which prepares them for a variety of occupations of which the placement service has little knowledge. As a result, this department has attempted to identify viable areas for graduates to pursue. As faculty members are contacted by potential employers, they post leads on a bulletin board for the students. These students must use their own initiative in seeking employment, but placements do exist and graduates have excellent success in securing them once they are identified.

Approximately 20 percent of the graduates continue their schooling. Of all of the three hundred and eighty-seven B.S.E.H. and M.S.E.H. graduates combined, approximately 8 percent have accepted placements with industry, another 5 percent are employed by health care institutions, 22 percent are enlisted in the military in related positions, and 65 percent are working with state or federal agencies.

PROGRAM PROJECTIONS

As has already been discussed, plans are underway to incorporate options for specialization. In addition to the specialization options it is hoped that an emphasis on occupational safety and health will be developed.

The most immediate development in this department is the addition of a Ph.D. option which will admit four or five students in the fall of 1979.

COURSE DESCRIPTION

Requirements:

1010 Personal Health - Various aspects of physical, mental, and social well-being. Attempts to create greater appreciation and understanding of health, which should be reflected in more intelligent self-direction of health behavior. (3 q.h.)

2310 General Microbiology - Bacteria and other microorganisms that have bearing on physical and economic well-being of man. (4 q.h.)

3000 Human Anatomy - Structure of the human body with emphasis on the relationship of structure and function. Skeletons, manikins, and slides are used for laboratory study. Rhesus monkeys are dissected. (4 q.h.)

3020 Human Physiology - Functions of cells, tissues, organs, and systems. Illustration of many physiologic processes. Human subjucts used in some exercises and laboratory animals used in others. (4 q.h.)

3060 Introduction to Environmental Health - Major areas of environmental health and areas of environment that come under the influence of the Sanitarian. Origin and progress of the environmental health field. Role of the sanitarian. (3 q.h.)

3080 Principles of Epidemiology - Introduction to principles of epidemiology and their application to investigation and measures for control and prevention of disease. (3 q.h.)

3100 Water Supplies and Wastewater Treatment - Introduction to water and wastewater treatment, municipal, semi-private and individual systems. Review of sources, chemical and bacteriological quality, and water pollution. (3 q.h.)

3240 Environmental Control of Insects and Parasitism - Importance of animal parasites and vectors in the spread of human disease. Emphasis on ways in which infections are contracted and spread, and methods of control. (4 q.h.)

3390 Health Communications - Designed to help the student to speak and communicate more purposefully in his/her profession. Includes study in outlining, writing for the press, practice in interviews, acceptable conversation, telephonic personality, acceptable written and spoken English, report preparation and report writing, public address and organization, methods in note-taking, and other professional communication considerations. (3 q.h.)

3400 Introduction to Air Pollution - Causes, effects, and control of air pollution. Emphasis on ways individuals, communities, metropolitan areas, and industry can prevent or control pollution. (3 q.h.)

3500 Environmental Safety - Principles and practices of environmental health and safety in natural bathing places, swimming pools, camp sites, parks, day nurseries, schools, colleges and universities. (3 q.h.)

3600 Food Sanitation Principles - Food composition, engineering principles, processing and preservation methods, food-borne diseases, and food regulatory programs. (3 q.h.)

3700 Solid Waste Management - Problems and solutions in generation, storage, collection, and disposal of solid wastes. Management aspects of planning, designing, organizing and operating refuse collection and disposal systems. (3 q.h.)

4030 Community Health - Health problems of communities and their causes. Work of various agencies concerned with community health, and the individual's responsibilities for community health. Health education. (3 q.h.)

4080 Environmental Health Practice - The environmental health aspects of nursing homes, schools, colleges, hospitals, camp sites, and recreational areas are studied. (3 q.h.)

4100 Environmental Health Aspects of Housing and Medical Care Facilities - Principles of healthful housing, and environmental control of hospitals, nursing homes, mobile homes, motels, hotels, penal institutions, and laboratories. (3 q.h.)

4200 Introduction to Radiological Health - Basic principles and procedures pertaining to safe control of all common sources of ionizing radiation. Causes, effects, and control of radiation are included. Laboratory experiments include safety monitoring, radiation detection, and use of survey meters. (4 q.h.)

4340 Occupational Health - Health problems encountered in industry and various occupations. Emphasis on causes of occupational diseases and ways to prevent the diseases. Introduction to types of radiation, with emphasis on controlling amount of radiation a person receives. (3 q.h.)

4360 Introduction to Vital Statistics - Statistical logic and elementary techniques of statistical analysis as applied to health. Collection and interpretation of population, natality, morbidity, and mortality statistics and elementary probability, sampling, and tests of significance will be considered. (3 q.h.)

4370 Public Health Sanitation - Critical analysis of environmental health principles, procedures, and practices. Emphasis on application of sanitary science in providing healthful environment. (5 q.h.)

4380 Biological Foundations of Sanitation - Basic principles of microbiology with emphasis on morphology, infection and effects of chemical and physical agents. Parasites and arthropods of medical importance, their recognition, life cycles, and methods of control. (4 q.h.)

4390 Environmental Health Equipment - Basic principles of physical factors necessary for practicing environmental health. Surveying, soil topography, hydraulics, pumps, valves, plumbing, chlorinators, pressure tanks, environmental design and environmental equipment. (3 q.h.)

4395 Environmental Analysis - Training in physical and chemical analysis of water, wastewater, food, air, and toxic materials. Experience in use of chemical instruments, as well as field test kits. (4 q.h.)

4400 Environmental Health Program-Planning - How to plan and evaluate environmental health programs. Availability of resources and relationship with other health agencies. (3 q.h.)

INSTITUTION: EAST TENNESSEE STATE UNIVERSITY (ETSU)

PROGRAM: Environmental Health

DEPARTMENT: Environmental Health

DEGREE: Master of Science in Environmental Health (M.S.E.H.)

CONTACT: Dr. Monroe T. Morgan, Chairman
Department of Environmental Health
East Tennessee State University
Johnson City, Tennessee 37601
(615) 929-4268

PROGRAM DESCRIPTION:

PROGRAM STRUCTURE

This program began as an outgrowth of the Bachelor of Science in Environmental Health in 1971. While the primary thrust of this department is to train personnel who are capable of coordinating and communicating with various specialists in environmental disciplines, two options for study are offered. Administrative Option graduates are qualified environmental program coordinators, environmental planners, environmental health administrators and human ecologists. Graduates of the Specialist option will be qualified in one of the four disciplines: air pollution specialist, water pollution specialist, solid waste specialist, or industrial health specialist. Career potential for the specialist exists in the fields of consumer safety, milk and food technology, insect and rodent control, public health, solid waste management, air pollution control, water and wastewater management, or industrial hygiene.

This was the first M.S.E.H. to be accredited by the National Accreditation Council of the National Environmental Health Association and has since been the model for environmental health program accreditation criteria at the graduate level.

During each spring quarter, one of the department's three laboratories is designated for graduate thesis research only to allow students to work undisturbed. The Veteran's Administration Hospital is adjacent to the ETSU campus and provides additional support.

PROGRAM REQUIREMENTS

In order to be eligible for graduate study, the student must have completed a baccalaureate degree from an accredited institution with a 2.5 grade average (on a 4.0 scale). Students entering the specialist program must have taken at least thirty quarter hours of health, biological, physical, and/or sanitary sciences and having had work experience is desirable. Those in the administrative option must have had a minimum of three years of environmental health field experience. Undergraduate deficiencies must be completed prior to admission to the graduate program.

General requirements for a major include forty-two quarter credits of specified courses in the department and approved electives. Additionally, three hours of research and three hours of thesis work are required. Each student must pass a final oral examination which is primarily a thesis defense but is not limited to it.

A minor may be completed with eighteen hours of courses at the graduate level which have been approved by the student's committee member from the department.

CURRENT FACULTY, STUDENTS, GRADUATES

Eight full-time and one part-time faculty comprise the teaching staff of this department. Involvement in research is marginal although this may be expected to change in the near future. A new university administration is giving priority status to developing an active research effort in this and other departments on campus.

There are forty students enrolled in this program, fifteen of whom are in the administration option. Given the current faculty size and teaching/research facility, this is the ceiling enrollment anticipated. Since 1971 there have been an average of twenty-four persons graduating each year (one hundred and sixty-six in all). Approximately 90 percent of the students receive some type of financial assistance. A sampling of the agencies providing support are the United States Army, the World Health Organization, and Aramco.

Because of the traditional concept of environmental health graduates as being sanitarians, use of the university placement office is discouraged. Employment leads are registered through the department itself and students have had good results in locating appropriate positions. Of a total of three hundred and eighty-seven graduates traced, eighty-seven enlisted in the military, thirty accepted positions with industry, twenty with health care institutions, and two hundred and fifty are with state and federal agencies. Two people pursued Ph.D.'s following graduation.

PROGRAM PROJECTIONS

Approval is being sought and plans are underway for a Ph.D. program in environmental health. Plans are to admit four or five Ph.D. candidates in the fall of 1979.

The specialist's option will soon include the topic of energy in keeping with the focus on our national need for new and environmentally sound methods for energy production.

Sources indicate a critical need for persons who are skilled in environmental land use planning, and the expertise for curriculum development along this line exists at ETSU. Not only at ETSU, but everywhere, professional developments must be brought into the classroom more quickly. It is also felt that the industrial involvement potential should be tapped in order to provide practical experience for the students. A primary development is the effort to change the widely accepted concept of environmental health graduates being qualified to fill no other occupation than that of sanitarian.

COURSE DESCRIPTION

Core Requirements for Administrative and Specialist Options:

5100 Environmental Health Practice I - Private and public sewerage and water systems, storage, collection and disposal of solid wastes. Field trips to local facilities. (3 q.h.)

5110 Environmental Health Practice II - Principles and practice in Public Health supervision of food and milk programs. Sanitary aspects of production, processing, handling, storage, and transportation of foods. (3 q.h.)

5300 Biostatics and Epidemiology - Techniques of collection, summarization, presentation and analysis of public health data. Epidemiology in solving health problems. Lecture and laboratory. (4 q.h.)

5870 Environmental Health in Public Law - Orientation to fields of Public Health and Environmental Health including historical background, human ecology, sanitation, public health laboratories, epidemiology, communicable disease control, and special services of each field. (3 q.h.)

5960 Thesis - (3 q.h.)

Specialist Option:

5200 Environmental Chemistry - Inorganic, organic, qualitative, quantitative and biochemistry for environmental control. (4 q.h.)

5650 Environmental Microbiology - Biology, microbiology, biochemistry, and physiology as they pertain to environmental health. (4 q.h.)

Air Pollution Specialist:

5500 Air Pollution Principles - Introduction to field of air pollution including sources, emissions, atmospheric dispersion, 5500 (Cont'd) - effects on humans, materials and control equipment. (3 q.h.)

Water Pollution Specialist:

5600 Water Pollution Principles - Sources, causes and effects of water pollution. Emphasis on methods of control of physical, chemical and biological factors. (3 q.h.)

Industrial Health Specialist:

5700 Industrial Hygiene - Occupational disease hazards and preventive measures for control including exposure to dusts, gases, vapors, fumes, and mist. Field trips to industry. (3 q.h.)

Solid Waste Specialist:

5840 Solid Waste Management - Problems and solutions to storage, collection and disposal of solid waste. (3 q.h.)

Courses Required in Administrative Option:

5860 Environmental Health Administration - Organizational structure, forces of management, administrative controls, personnel and financial management, legal aspects of environmental health programs and organizations. Lecture, discussion, seminar and group exercises. (3 q.h.)

5880 Environmental Health Management - Continuation of 5860 with emphasis on environmental management practice by use of case studies, group dynamics, the incident process, the in-basket exercises, the political process, and the executive process. (3 q.h.)

5890 Environmental Planning - Planning process of the environment as it relates to health and welfare of the community. (3 q.h.9

Political Science 5730 Urban Government - Research into problems and challenges facing urban American society. (3 q.h.)

Graduate Electives:

5140 Principles of Sanitary Science - Fundamental basis of sanitary science to establish interrelations and applications of mathematics, 5140 (Cont'd) - physics, fluid mechanics in the control of the environment. (3 q.h.)

5400 Consumer Protection and Environmental Design - Introduction to principles, methods and programs of consumer protection. Emphasis on household products, appliances and environmental design as to promote safety and positive health in the community. (3 q.h.)

5510 Air Pollution Control - Specialized, technical aspects of air pollution control, including sampling from ambient air and stacks, analysis techniques, meteorological considerations, dispersion of stack effluents, control technology, and others. (3 q.h.)

5610 Water Pollution Control - Specialized technical aspects of water pollution control including dissolved oxygen relations in streams, techniques of sampling and analysis, water pollution control surveys, considerations in the design of water pollution control facilities, mathematical description of treatment processes, and others. (3 q.h.)

5750 Institutional Health - Environmental aspects of hospitals, nursing homes, penal institutions and schools. Environments are studied for biological, chemical and physical requirements. (4 q.h.)

5760 Housing Hygiene and Urban Development - Principles and practice of healthful housing including urban planning, aspects of solid and liquid waste disposal, environmental pollution, air, water, noise, and land. (3 q.h.)

5800 Environmental Radiation - Principles of ionizing radiation, interreactions with matter, and biological effects. Laboratory exercises concerning detection and measurement of ionizing radiation with emphasis on control. (4 q.h.)

5850 Insect and Vector Control - Lectures, problems and demonstrations given to the biological and physical application of modern techniques for the control of vectors. Chemical control measures including materials, formulation and safe application of insecticides, rodenticides, and fumigants. (3 q.h.)

5900-5901-5902-5903 Special Problems in Environmental Health - Independent or cooperative investigation of specific problems in Environmental Health. ((2-4 q.h.)

5910 Seminar - A study of the principles, materials and methods of research employed in Environmental Health. (1-3 q.h.)

5950 Research in Environmental Health - (3 q.h.)

Recommended and approved electives: All 5000 Environmental Health courses; 4267 Local Government Financing; 5220 Health Education; 5760 Microbiology - all subject to approval by the student's advisory committee.

INSTITUTION: FERRIS STATE COLLEGE

PROGRAM: Environmental Health Technician (A.A.S.)
Environmental Health (B.S.)

DEPARTMENT: Environmental Quality Programs

DEGREE: Associate of Applied Science (A.A.S.)
Bachelor of Science (B.S.)

CONTACT: Mr. John R. Fleming
School of Allied Health
Ferris State College
Big Rapids, Michigan 49307
(616) 796-9971

PROGRAM DESCRIPTION:

PROGRAM STRUCTURE

The A.A.S. program began in 1957 and has had 332 graduates to date. The B.S. program began in 1963 and has had 403 graduates to date. The Environmental Health curriculum is designed for students who wish to prepare themselves as professional sanitarians. Emphasis is placed upon course content related to supervisory and administrative functions in environmental control.

PROGRAM REQUIREMENTS

The A.A.S. degree required six college quarters (96 quarter hours). Field training with a full-time health department is provided during the latter part of the second year. The B.S. requires 186 quarter hours. All students qualifying for the B.S. degree in Environmental Health must complete a total of at least 78 quarter hours in courses related to the fundamental of environmental health technology and practice. All students must complete the core of environmental studies comprising 37 quarter hours. Four optional B.S. programs of study are available: general environmental health, vector control, occupational health, environmental planning and management.

A program is also available that enables the individuals to complete the B.S. requirements with a minimum of required residence study. The curriculum for this option anticipates maximum utilization which have been obtained through any accredited college or university, American Council on Education approved military training, PHS-Center for Disease Control Home Study Program, or other similar training or learning experience.

CURRENT FACULTY, STUDENTS, GRADUATES

The number of instructional faculty is five. There are two special project faculty and part-time instructors and one department head. Currently there are 82 B.S. and 29 A.A.S. students who are pursuing environmental health studies (air, water, wastewater, noise, radiation, etc.). In recent years, there has been a decline in the number of A.A.S. graduates and an increase in B.S. graduates. The 1976-77 graduates number 11 for the A.A.S. and 50 for the B.S. It is estimated that 40 percent of the graduates find employment in the private sector and 60 percent in government positions.

COURSE DESCRIPTION (a partial listing)

E-H 101 Environmental Health Practices - A study of the development and organization of environmental health practices and the related public health services. Special emphasis will be placed upon the scope and fundamentals of environmental systems and their related technologies. (3 q.h.)

E-H 208 Solid Waste Management - This course is designed to study the problems and solutions to the storage, collection and disposal of solid waste. Course content includes the organization, operation and control of solid waste collection and disposal systems. (2 q.h.)

E-H 211 Water Supply and Pollution Control - A study of water management and systems of water supply and pollution control practices. Emphasis is upon water composition and quality, the development and protection of ground and surface water supplies and water treatment processes. Field trips stress the practical application of classroom lectures. (4 q.h.)

E-H 214 Vector Control - A general survey of the endoparasites and arthropods of public health importance. Emphasis is placed upon environmental and chemical control of vestors which affect man. (4 q.h.)

E-H 218 Environmental Health Laboratory - An introduction to environmental health surveillance practices utilizing the chemical and microbiological techniques of sampling, transporting, testing and interpreting test results. Emphasis will be placed upon procedures utilized for water pollution control, milk and food control, swimming pools, natural bathing areas and surface testing. (4 q.h.)

E-H 222 Environmental Health Internship - Eight weeks in on-the-job training at a county health department designated as a training center by the Michigan Department of Public Health. Students receive practical training and field experience in environmental control programs and health department-community relations. (4 q.h.)

E-H 303 Air Pollution - A comprehensive survey of community air pollution. Emphasis will be upon the air pollution problems and the strategies used for its control. The student will be taught the use of air monitoring and meteorological equipment and to effectively use the facts, ideas, or concepts, learned to interpret and solve air pollution problems. (4 q.h.)

E-H 310 Environmental Radiation - The course is designed to deal with the harmful effects of ionizing radiation. In includes procedures for radiation protection surveys, area and personnel monitoring, permissible levels of radiation in unrestricted areas and concentration in effluents. (3 q.h.)

E-H 316 Noise Control - A study of the nature of sound and its relationships to health. Emphasis is placed upon the principles and procedures employed in the measurement, evaluation and control of noise in the occupational and non-occupational environment. (3 q.h.)

E-H 405 Industrial Hygiene - A course on the problems of occupational disease hazards and measures for their prevention and control. Recognition, evaluation and control of environmental factors or stresses arising in or from the workplace are emphasized. Basic technology for assessing exposure to dusts, gases, vapors, fumes, mist and other problems related to industrial health and safety is covered. (4 q.h.)

E-H 409 Environmental Management - A study of approaches and processes essential to the management of the environment in terms of modern health concepts. Community planning practices, comprehensive health relationships and current and emerging environmental issues will be discussed. Case histories and field studies will be correlated with lectures. (4 q.h.)

EHN 211 Waterborne Disease Control - This course stresses control of waterborne diseases through water treatment and control. The transmissable diseases, the protection of water supplies, water chemistry, potable water standards, common water sources, and the sampling and testing procedures are covered. (6 q.h.)

INSTITUTION: FLORIDA INTERNATIONAL UNIVERSITY

PROGRAM: Civil Engineering Technology Option

DEPARTMENT: Engineering Technology

DEGREE: Bachelor of Science

CONTACT: Dr. Jose Villate, Coordinator
Environmental and Urban Systems
School of Technology
Florida International University
Tamiami Trail
Miami, Florida 33199
(305) 552-2824

PROGRAM DESCRIPTION:

PROGRAM STRUCTURE

Since this program's inception, in 1973, it has been a part of the Division of Environmental and Urban Systems. Late in 1977, however, a decision was made that the program would be revised and merged with the Civil Engineering Technology program of the school's Construction Division. Students will earn a B.S. degree in civil engineering technology with the environmental option rather than a B.S. degree in environmental and urban systems. Officials believe that students taking the proposed curriculum will be provided a broader and more useful background. Graduates will be qualified to perform the duties of the environmental engineer or the environmental planner.

Undergraduate curriculums at the university are upper-divisional; the last two years of study are offered, and students normally transfer from community colleges after completion of the associate degree. Florida law outlines the required sequence of courses at the lower division for transfer to upper division programs.

From the time the program was developed and implemented, program officials have worked towards acquiring adequate facilities, developing a master's degree program in aquatic resources, and promoting faculty stability. Therefore, little environmental research has yet been carried out; this will become a priority in the future.

PROGRAM REQUIREMENTS

Specific entrance requirements and the curriculum format have been finalized for the revised program and a proposed curriculum has been developed. Students without the required preparatory courses may take them while completing the upper-division program by taking additional electives.

Under the Division of Environmental and Urban Systems, students were required to take forty-five quarter hours of core courses in the areas of air resources, environmental health, environmental management, transportation, urban planning, technological systems, hydraulics, water resources and aquatic systems. Additional courses for environmental systems were required in unit operations, water supply systems, computers, and engineering economy. Twenty hours of electives could be selected with an advisor.

Under the new plan, three environmental options will be available under the Civil Engineering Technology program: Environmental Systems, Planning Systems, and Transportation Systems. Students taking all three options would take the following civil engineering courses: Advanced Surveying Codes and Specifications, Strength of Materials, Materials Testing, Determinate Structural Analysis, Soil Mechanics and Foundations, Soil Mechanics Laboratory, Undeterminate Structural Analysis, Traffic and Transportation Engineering Technology, Reinforced Concrete Design, Engineering Economy, and Dynamics. Additional required courses taken would depend upon the student's concentration; these courses would be within the major field. A minimum of ninety quarter hours is required for graduation.

No special sources of financial assistance are available to students in this program. Although there is no formalized internship program, students may make appropriate arrangements and receive academic credit for related work experience under certain circumstances.

CURRENT FACULTY, STUDENTS, GRADUATES

Five faculty members teach environmental engineering technology courses full-time, and several adjunct professors from environmental agencies or industries teach courses on a part-time basis. An estimated sixty-five students are currently enrolled in the curriculum. Approximately 80 percent of these students attend school part-time while holding full-time jobs. Many already work in environmental fields.

An average of twelve persons graduates annually from this program, representing a gradual increase since the program's inception. Several graduates have continued their schooling, according to program officials, and all those seeking to find employment in the environmental field have been able to do so. An estimated 30 percent have entered the private sector, while the remainder have joined governmental agencies.

PROGRAM PROJECTIONS

Efforts will be focused upon implementing the new curriculum through the merger with the civil engineering program. Program officials foresee offering a broad technical engineering curriculum stressing long-term humanistic values. The number of students and faculty is not expected to increase appreciably, as quality will be emphasized more than quantity.

COURSE DESCRIPTION

EUS 310 Air Resources - Characteristics of the earth's atmosphere and aspects of air pollution. Classification and sources of air pollutants; effects of air pollutants on health, vegetation and property; control measures, legislation and projections. (5 q.h.)

EUS 330 Introduction to Transportation Systems - Role of transportation in urban and regional development; elements of the transportation system; characteristics and design considerations of various modes; the travel way; facilities; control and guidance; selected design standards and technology; operational characteristics; planning techniques. (5 q.h.)

EUS 340 Urban Planning Concepts - Planning fundamentals; objectives and scope of urban planning; theories of land use patterns; population studies; cohort survival techniques; employment studies; economic studies; estimating demand for various land usage; physical, social, political and managerial conditions; comprehensive plan and its elements; aesthetics and design concepts of communities; implementation tactics. (5 q.h.)

EUS 350 Applied Hydraulics - Background in basic hydraulic technology. The fundamental theorems are studies first then applied to the collection and distribution of water and to the collection and treatment of wastewaters. (5 q.h.)

EUS 352 Water Resources - Study of the hydrologic cycle; ground and surface water occurrence and quality; sanitary protection of surface and groundwater; sources of pollution; water quality management; multipurpose uses of water and reuse; determination of municipal, industrial and agricultural water requirements. (5 q.h.)

EUS 356 Aquatic Systems - Biological, chemical and physical aspects of freshwater lentic and lotic ecosystems. Emphasis is placed on the freshwater systems of South Florida. (5 q.h.)

EUS 430 Transportation Planning - Principles of transportation planning; origin-destination studies; methodology used in generating transportation plans; techniques for predicting and evaluating the consequences of various alternatives; transportation planning for the Dade County region. (5 q.h.)

EUS 445 Urban Land Use Planning - Elements of the general land use plan; location and space requirements; the use of models in planning; development of the land use plan; policy plan; implementation. (5 q.h.)

EUS 449 Planning Implementation - Planning law and administration: practice in formulation of zoning ordinance; land subdivision, urban renewal; trends and innovations in control of growth - case studies in the U.S.; critical path method; planning, programming, budgeting systems and capital improvement programs. (5 q.h.)

EUS 450 Unit Operations I - Principles of wastewater treatment. Physical and biological unit treatment operations including sludge digestion. Significance of laboratory tests. Laboratory work. Occasional field trips are required. (5 q.h.)

EUS 451 Unit Operations II - A continuation of EUS 450 incorporating chemical unit operations including effluent disinfection. Laboratory work. Occasional field trips are required. (5 q.h.)

EUS 455 Water Supply Systems - Development of water supplies; treatment of water including disinfection techniques. Distribution systems. Laboratory work. (5 q.h.)

INSTITUTION: GEORGIA INSTITUTE OF TECHNOLOGY

PROGRAM: Environmental Studies

DEPARTMENT: College of Engineering (multidisciplinary)

DEGREE: Certificate of Achievement

CONTACT: Dr. Charles R. Vail, P.E., Associate Dean
College of Engineering
Georgia Institute of Technology
225 North Avenue, N.W.
Atlanta, Georgia 30332
(404) 894-3354

PROGRAM DESCRIPTION:

PROGRAM STRUCTURE

The College of Engineering offers students majoring in the standard engineering disciplines (i.e., aerospace engineering, chemical engineering, civil engineering, electrical engineering, engineering science and mechanics, industrial and systems engineering, mechanical engineering, and nuclear engineering), the opportunity to choose their electives in such a way as to permit them to qualify for receipt of a Certificate of Achievement in Environmental Studies. This option is open to master's and doctoral students only.

The multidisciplinary environmental studies program enables the graduate student to bring the expertise of his or her disciplinary major to bear on problems in the broad area of environmental engineering. Environmental Studies also provides the opportunity for a student to learn how his or her major discipline can be interrelated with other major disciplines so as to effect solutions to complex applicational problems in such areas as water quality, air pollution, marine technology, solid waste technology, radiation hazards, noise, energy usage, thermal pollution, and urban problems. A wide range of approved courses distributed through virtually all engineering and science schools of the Institute constitutes a source from which the student's advisor draws those which will constitute the multidisciplinary program of that individual student.

Students who wish to receive the certificate must fulfill all of the degree requirements of their "home" discipline in addition to meeting those for the certificate. Graduates will be able to work in the traditional occupations of their school of engineering, in addition to being fit for employment in their chosen environmental specialty area.

PROGRAM REQUIREMENTS

Full graduate level status is accorded applicants holding a bachelor's degree from an approved institution, and whose previous work has been of a nature and quality sufficient to offer reasonable assurance of success in advanced study. A conditional graduate standing will be assigned those entrants whose previous work shows deficiencies in either content or quality.

Specific graduate level certificate requirements include: a minimum of twenty-four credit hours of approved course work in a coherent package; six credit hours of approved special problem or thesis work; chosen specialty courses must relate to one's major degree atea; at least six credit hours must be outside the major field; and a grade of B or better must be earned on each course being counted toward the certificate. Certificate requirements are the same for both master's and doctoral students.

CURRENT FACULTY, STUDENTS, GRADUATES

Environmental Studies is administered by one faculty member from each of the eight cooperating departments. In addition, one faculty member each from textiles engineering, architecture, biology, chemistry and physics are involved in committee activities, in anticipation of their departments' soon offering the Environmental Studies certificate program.

Students do not declare that they are pursuing this certificate until one quarter prior to their graduation, and for this reason it is impossible to estimate how many students are involved. In 1976 four environmental studies certificates were awarded and in 1977 one was awarded, both to master's graduates, a total of five for this program.

PROGRAM PROJECTIONS

The multidisciplinary approach to a particular problem area appears to be an important development in environmental education, and in the industrial sector is causing something of a "stir". These types of programs are being expanded to create degree programs in which three or more schools of engineering would be involved in the fulfillment of degree requirements. Expansion of multidisciplinary certificate level programs will continue, as this program concept has been very well received among faculty. It is significant to note that an increasing number of requests for information on Environmental Studies has been received, and also there is an on-campus recruitment effort under way which is becoming effective, in the estimation of a program official.

COURSE DESCRIPTION (SELECTED)

A.E. 6300 Meteorology and Atmospheric Dynamics - Introduction to dynamical and physical processes of natural weather systems, hydrostatic stability and convection, radiation and heat in

A.E. 6300 (Cont'd) - atmosphere, planned and inadvertent weather modification. (3 q.h.)

A.E. 6301 Turbulence and Atmospheric Dynamics - Introduction to turbulence, turbulent transport of momentum and heat, dynamics of turbulence, boundary-free and wall-bound shear flows, statistical description and spectral dynamics of turbulence. (3 q.h.)

A.E. 6302 Air Pollution Meteorology - Fundamentals of air pollution meteorology, engineering approach to atmospheric diffusion, natural removal processes, urban and regional problems, meterological instruments, air pollution climatology. (3 q.h.)

A.E. 6303 Atmospheric Boundary Layer - Structure and aerodynamic characteristics of atmospheric boundary layer, turbulent transport of contaminants in environment, stratified and disturbed atmospheric boundary layer, free-convection layer, current problems. (3 q.h.)

A.E. 6304 Aerospace Systems and the Environment - Effects of aerospace vehicle on environment, pollutant emissions from vehicles, chemistry and effects of emission in troposphere and stratosphere, methods of emission reduction, current problems. (3 q.h.)

A.E. 6460 Aerodynamic Noise - Jet, boundary layer, combustion, propeller and fan noise. Sonic boom, noise propagation from engines and attenuation techniques. (3 q.h.)

Chem. 5201 Analysis of Atmospheric Contaminants - Modern analytical techniques and instrumental methods of analysis including applications involving measurement of air contaminants. (3 q.h.)

C.E. 6358 Issues in Water Resources Planning and Management - Major public policy issues in water resource planning and management. Emphasis on American issues, but appropriate reference to issues in other countries. (3 q.h.)

C.E. 6363 Economics of Water Resources Development - Principles of resource allocation, benefit-cost analysis, water-resources project formulation, justification, allocation of joint costs in multipurpose developments. (2 q.h.)

C.E. 6368 Applied Environmental Resources Management - Field, laboratory and classroom studies applied to the solution of an environmental management problem under the direction of a multidisciplinary faculty team. (1 q.h.)

C.E. 6124 Air Pollution Measurements and Control - Analysis of air pollution problems of cities and industries, methods of evaluating the problems. Description, design and use of air sampling equipment. (3 q.h.)

C.E. 6128 Solid Waste Technology II - Evaluation of typical solid waste problems, application of fundamental principles to design and management, case studies of operational solid waste systems, new methods, advanced topics.. (2 q.h.)

N.E. 6643 Environmental Impact of Nuclear Power Stations - Specific impact of nuclear facilities on the environment. Practical and regulatory aspects of reactor siting and the preparation of environmental impact statements. (3 q.h.)

M.E. 4327 Combustion and Flames - Stoichiometric and thermochemical analysis of fuel-oxidant reactions. Heat and mass transfer with chemical reaction applied to combustion of gas jets, solid and liquid fuels. (3 q.h.)

N.E. 6235 Nuclear Reactor Safety - Licensing procedures, sources of potential hazard, accident transients, engineered safeguards, incipient failure, diagnostic techniques and safety analysis reports are discussed. (3 q.h.)

N.E. 6251 Fundamentals of Nuclear Engineering - Reactor principles, operation, materials, control and use. (3 q.h.)

N.E. 6401 Radiological Health Physics - An evaluation of radiation protection standards, their development and enforcement. Covers topics such as effects of radiation, internal and external exposure, health physics practice and dosimetry. (3 q.h.)

INSTITUTION: HEED UNIVERSITY

PROGRAM: Ocean and Environment Affairs

DEPARTMENT: Ocean and Environment Affairs

DEGREE: Master of Arts (M.A)
Doctor of Philosophy (Ph.D.)

CONTACT: Dr. Walter J. McNichols
Dean and Coordinator of Ocean and Environment Affairs
Heed University
Box 311
Hollywood, Florida 33022
(305) 925-1600

PROGRAM DESCRIPTION:

PROGRAM STRUCTURE

Heed University, chartered in 1970, is a private, not-for-profit, non-sectarian institution of higher learning. It offers graduate degrees in Business, Ocean and Environment Affairs, Education and Psychology. The "University without walls" philosophy is followed, and the student body comes from all over the country, attending classes at the university several months out of each year. During the remainder of the year, students work independently, though under advisement, carrying out research, projects, and dissertation writing. The curriculum format is particularly attractive to persons who prefer to earn a degree while continuing full-time employment.

The university is licensed by the Florida State Board of Independent Colleges and Universities and has applied for accreditation with the Southern Association of Colleges and Schools. Two research grants related to ocean and environment affairs have been awarded to Heed University from the Federal Office of Sea Grant (National Oceanic and Atmospheric Administration). The university plans to develop additional research programs.

PROGRAM REQUIREMENTS

To enter a master's degree program at Heed University, a prospective student must have earned a bachelor's degree, and have had a minimum of three years of successful experience in employment. Three years of successful employment are also required to enter the Ph.D. programs, as is a master's degree or the equivalent.

Thirty-six semester credits are required for the master's degree. Of these, a maximum of six credits may be transferred from other institutions. Students carry out projects or theses for six credits each, and normally twelve credits are earned in residence. The remaining credits may be earned with additional projects, independent study, and/or with more courses or seminars in residence.

The doctoral program requires eighty credits above the master's degree. A maximum of twelve credits may be transferred and twenty-four credits must be earned in residence. Satisfactory completion of a prospectus and detailed outline of the dissertation earn ten credits, while completion of the dissertation itself also contributes ten credits. The remaining credits may be earned through independent study, projects, or additional residence work. Oral presentations and defenses of dissertations or major projects are carried out at the university during summer sessions.

Each doctoral candidate is assigned one major advisor and one minor advisor. Students in master's programs are assigned one of each. Selection of advisors is based first on discipline and second on geographic proximity to the student. Advisors help in selecting appropriate course work, and research projects, and often participate in oral proceedings.

There are no required courses, sequences, or seminars for Heed University students; much flexibility is allowed in choosing courses of study, which are tailored to meet individual career objectives. Seminars are held at the university eight weeks during the summer and one to two weeks in April and December. These seminars are interdisciplinary, and students earn three credits for each week of attendance. Many focus on research techniques, while others cover such topics as psychoanalysis and interpersonal relations. A curriculum committee meets regulary and makes program recommendations. Students, however, are given voice in seminar offerings and curriculum decision-making.

There are no predetermined requirements for obtaining a concentration in Ocean and Environment Affairs. The adequacy of a chosen course of study is determined by the university administrators and advisors. Degrees are awarded only when students have met all the requirements of the university and accrediting bodies, and all work has been of acceptable quality.

CURRENT FACULTY, STUDENTS, GRADUATES

There are approximately two hundred students enrolled in Heed University programs. Three of these are in the Ocean and Environment Affairs Ph.D. program. Ten persons to date have gained the Ph.D. with this concentration, with an average of two to three per year; there have been no students enrolled in the master's program. No graduates have sought employment in the field, as most already held jobs in some way environmentally related. Approximately 90 percent of the university's enrollment consists of out-of-state students.

Heed University has a core of faculty of about fourteen members. The large majority works with the school on a part-time basis. Numerous other persons throughout the country work with the university part-time, acting as advisors to students, and sometimes teaching seminars in residence. The adjunct faculty is a highly educated group with all having earned doctorates such as Doctor of Philosophy (Ph.D.), Doctor of Medicine (M.D.), and Doctor of Education (Ed.D.).

PROGRAM PROJECTIONS

Administrators hope to increase enrollment in the Ocean and Environment Affairs programs to forty or fifty. No curriculum changes are currently anticipated, although the curriculum committee will continually carry out internal reviews and make recommendations as deemed necessary.

COURSE DESCRIPTION

The following course listing is suggested only, and not limiting. Course credits may be earned externally on an independent study plan under faculty supervision. On-campus seminars are normally devoted to research and interdisciplinary studies. Any course may be offered on campus if a minimum of eight students register for that course.

HEA	6001	Environmental Affairs - Survey
HEA	6002	Coastal Zone - Problems
HEA	6003	Coastal Zone Management
HEA	6004	Fisheries
HEA	6005	Territorial Sea and Contiguous Zone
HEA	6006	Continental Shelf
HEA	6007	Deep Ocean - Problems
HEA	6008	Submarine Geology and Geophysics
HEA	6009	Ocean Engineering
HEA	6010	Air Pollution - Survey
HEA	6011	Water Pollution - Survey
HEA	6012	Guided Research
HEA	6013	Independent Study
HEA	6014	Governmental Aspects - Federal
HEA	6015	Governmental Aspects - State and Local
HEA	6016	Governmental Aspects - International
HEA	6017	Advanced Research
HEA	6018	Advanced Independent Study

INSTITUTION: HOCKING TECHNICAL COLLEGE

PROGRAM: Environmental Health Technology

DEPARTMENT: Natural Resources

DEGREE: Associate of Applied Science

CONTACT: Mr. David Mingus, Coordinator
Environmental Health Technology
Rt. 1
Hocking Technical College
Nelsonville, Ohio 45764
(614) 753-3591

PROGRAM DESCRIPTION:

PROGRAM STRUCTURE

The first of its kind in Ohio, the Environmental Health Technology (EHT) program at Hocking Technical College trains technicians in the inspection, investigation, and reporting of environmental conditions for professional health and management personnel. In many instances, graduates also assist in the education of the community to increase its understanding of what its environmental problems are and what practical solutions are available. Though the emphasis of the program is on teaching, rather than research, basic facilities include chemistry, biology, and bacteriology labs and water-testing equipment. Students are extensively involved in field work. Faculty periodically conduct workshops on a variety of environmental topics for local sanitarians and teachers. Advisory committee members from education, health services, natural resources, and industry provide curriculum oversight.

PROGRAM REQUIREMENTS

Admission to Hocking Technical requires a high school diploma or G.E.D. certificate and an interest and attitude in the technology selected. Adults who lack a high school diploma or equivalency may receive permission to enroll if it is determined that they possess the basic ability to succeed in a technical program. Students must maintain a 2.0 overall average and a 2.0 in their major field. The basic EHT plant of study includes 106 quarter hours exclusive of an optional internship during the summer term.

CURRENT FACULTY, STUDENTS, GRADUATES

Faculty lines total 2.5 FTE in the Environmental Health program. Of the 32 first-year and 21 second-year students, approximately 15 percent are women. Though there are many veterans in the program, few students have moved from other careers to Environmental Health Technology. Recruitment efforts reach high schools across the state and focus intensively on a three-county area surrounding Nelsonville. Virtually all students are from Ohio.

On the average, the program produces 15 graduates annually. Roughly one-quarter of this number pursue additional degrees. Of those seeking employment, 85 percent are employed in their field and 15 percent in related technologies. Most students (99 percent) take jobs in the public sector. According to Hocking Technical's catalog, "the Environmental Health technician is a new job classification that provides mid-management opportunities with federal, state, and local health agencies." Other areas of opportunity are voluntary health agencies, industry with waste treatment services, and municipal water and sewage treatment plants.

Financial assistance programs available include Ohio Instructional Grants, Basic Educational Opportunity Grants, Supplemental Educational Opportunity Grants, guaranteed student loans, college work-study, Bureau of Vocational Rehabilitation monies, and scholarships. The Financial Aid Office at Hocking Technical works intensively to insure that any students who need monetary help to attend school receive it.

PROGRAM PROJECTIONS

Long-range goals of the Environmental Health Technology program are to expand the curriculum in the areas of wastewater treatment, pesticide licensing, grantsmanship, and National Food Service Industry (NFSI) certification. The school would also like to participate in the continuing environmental health training now required by Ohio law for sanitarians (3-6 hrs./year). Three grant proposals have been submitted to the Department of Health, Education, and Welfare for carbon monoxide training programs. The staff would like to set up training workshops and courses for area teachers; but because Hocking Technical is not a post-baccalaureate institution, this opportunity does not exist. The future of the Environmental Health Technology program, nevertheless, is bright, according to its staff personnel.

COURSE DESCRIPTION*

1831 Community Health Administration - A study of the history, the areas of responsibility now covered by public health agencies, various volunteer health services, and new public health areas. (3 q.h.)

1850 Public Health Law - A survey of the Ohio Revised Code and the Ohio Sanitation Code using case studies and related experiences to illustrate the relationship of public health problems and their legal problems.

1806 Environmental Health I - A survey of basic principles in water contact, air contact, and solid waste problems. The course includes field trips to see both good and bad practices of various community health services. (5 q.h.)

1870 Occupational Safety - A study of Ohio safety codes and accepted safety practices and procedures pertaining to employees and employers. (3 q.h.)

1880 Seminar - A series of lectures by public health officials covering duties, responsibilities, and manpower needs of their agencies. Public health control measures as applied by selected voluntary health agencies are also discussed. (3 q.h.)

1816 Food Protection - An in-depth study of food protection including local, state, and federal regulations concerning food protection, processing, and service operations. Epidemiological procedures in the collection and assimilation of data in food poisoning outbreaks are studied. (5 q.h.)

1385 Agronomy - An introductory course in soil science covering basic concepts of soil formation, the relationships between soil and vegetation types, composition, and basic conservation practices. The majority of the field work deals with soil sampling and soil testing. (3 q.h.)

1821 Environmental Engineering I - Air, water, and solid waste pollution problems and their causes, effects, and prevention are studied. Labs include practical application of air, water, and solid waste management, inspection, and control. (5 q.h.)

3203 Individual Studies in Environmental Health - By arrangement. (1-5 q.h.)

1891 Internship - On-the-job training in the environmental health field through special arrangement with an instructor of environmental health. (12 q.h.)

1810 Environmental Problems - An independent study in which the student chooses a specific area of the environment on which to do field work and/or text research and submit a term paper on that subject. (2 q.h.)

0354 Entomology - An introduction to the study of insects. Anatomy and major orders of insects are discussed in lecture sessions. Field collection and identification of insects collected are covered in laboratory sessions. (2 q.h.)

2836 Water Sewage and Wastewater Problems - A comprehensive study of regulations and standards of shelter, space, individual home sewage development and development of home water supplies. (5 q.h.)

1805 Ecology - A study of the effects of human population on national resources. (4 q.h.)

2840 Bacteriology - A study of the principles of bacteriology. Lab procedures provide experience in collection, isolation, culturing, staining, and identification of various microorganisms. (4 q.h.)

2837 Vector Control - A study of commonly encountered pests and their eradication. Various types of rodents, insects, and other pests such as pigeons are identified. Emphasis is on methods of control and the safety precautions necessary when handling various chemicals and infected vectors. (5 q.h.)

2851 Epidemiology - A study of communicable human diseases with emphasis on identification, frequency, distribution, control, and prevention of diseases endemic to this geographic area. (4 q.h.)

2861 Sanitation Lab Procedures - A review of methods of sample collection, specimen preservation, and laboratory procedures necessary to achieve accurate results. (3 q.h.)

2856 Public Area Sanitation - A study of public institutions such as camps, swimming pools, schools, and mobile home parks from the standpoints of design, construction maintenance, and sanitation. (5 q.h.)

*Courses listed in the sequence taken by a student.

INSTITUTION: HOWARD UNIVERSITY

PROGRAM: Environmental Engineering

DEPARTMENT: Civil Engineering

DEGREE: Master of Engineering

CONTACT: Professor James Johnson
Department of Civil Engineering
School of Engineering
Howard University
Washington, D.C. 20059
(202) 636-6565

PROGRAM DESCRIPTION:

PROGRAM STRUCTURE

The Environmental Engineering program, accredited by the ECPD, was organized in 1969. It is structured so that each program of study is best suited to the student's special interests. A balance between theory and practice is achieved through course and laboratory work. Laboratory facilities include two sampling stations, mobile source Pollution Monitoring Laboratory, and well-equipped Structures and Soils Mechanics Laboratories.

The program is structured so that students are prepared for work in governmental areas and for work with consulting firms. Instruction covers a wide spectrum of topics, including water chemistry, water and wastewater treatment, air resources, air pollution control and radiological health.

PROGRAM REQUIREMENTS

The Environmental Engineering program admits students with engineering or environmentally related degrees,e.g., science backgrounds. They must have maintained a 3.00 grade point average in undergraduate studies and have proved they are capable of the work required at the graduate level.

Once admitted, the student must complete a minimum of thirty credits, of which at least twenty must be in his/her major area. The thirty credits may be comprised of course work only, or including up to six credits of thesis work. Non-thesis students must include at least one project type course in their program. If no thesis is written, a written comprehensive examination must be taken. If a thesis is written, a final oral examination on the thesis submitted. There is no foreign language requirement unless the student is research oriented or intends to pursue further study.

Students receive financial support from various sources. These include graduate assistantships doing outside research, fellowships from the University, work study programs where the student works for companies outisde the University (only one or two students receive this form of aid), and research assistantships totalling up to five thousand dollars annually.

CURRENT FACULTY, STUDENTS, GRADUATES

There are currently four full-time faculty members on the teaching staff and one faculty member doing research. Research funding is available from a contract with American Can, O-Brien& Gere, and two contracts with Water Resources Institute. The department feels a strong need for more funding for basic research, and feels it might come from industrial sources.

Students are recruited through referrals from other students and schools, and publications. Twenty full-time and four part-time students are currently enrolled in the program. An average of ten students graduate annually. Through personal contact with the graduates, it is found that approximately ten percent go on to further schooling, fifty percent find employment in their field, and thirty-five percent find employment in related fields. Of those employed, half work for the government and half work for private agencies. The graduates are placed through the University placement office, considered the most effective means, and through referrals from faculty members in the Department, not quite as effective.

PROGRAM PROJECTIONS

The Environmental Engineering program plans to introduce a Ph.D. program in the near future. With the introduction of the program, it would be necessary to acquire one more staff member. The program also plans to introduce new workshops and seminars to the present curriculum and would like to introduce other courses applying physical and biological sciences to environmental problems. To implement the curriculum will take approximately six months, and the department will need more funding, in order to implement it fully.

COURSE DESCRIPTION

(the following is a partial listing of courses)

234-501 Water Treatment & Water Resources - Water resource systems planning in relation to demographics, chemicals, and biological factors. (3 s.h.)

234-502 Wastewater Treatment - Establishment of water quality control standards: analysis and adjustment of various wastewaters; design and specification of treatment units. (3 s.h.)

234-511 Chemistry of Water & Wastewater - Physical and chemical properties of water and wastewater. Kinetics equilibria in water and sewage, organic and inorganic constituents of water and its effect on man's environment. (3 s.h.)

234-516 Properties of Air Pollutants - Physical, chemical, geological, and social behavioral properties of dusts, droplets, and gases in the atmosphere. Air pollutant sampling and analysis. The planning and operation of air pollution surveys. (3 s.h.)

234-541 Radiological Health - The atomic nucleus, the radius of the nucleus, mass of nuclei and meutral atoms. Radioactive decay, alpha and gamma, beta, internal conversion and electron capture, spontaneous fission. Decay equations, equilibrium and induced activity. Photon interactions with matter, compton scattering and absorption, photoelectric effect, pair production, attenuation, absorption and energy transfer. (3 s.h.)

234-550 Water Quality Management - Mechanics and kinetics of stream and estuary pollution. Effects of natural processes and pollution by man. Types of pollutants: temperature, inorganic salts oxygen demanding contaminants, sediments, organic compounds, and nuclear wastes. Self-purification. (3 s.h.)

234-565 Air Pollution Control Standards - Mechanics and kinetics of stream and estuary pollution. Effects of natural processes and pollution by man. Types of pollutants: temperature, inorganic salts, oxygen demanding contaminants, sediments, organic compounds, and nuclear wastes. Self-purification. (3 s.h.)

234-566 Solid Waste Disposal - Study of traditional patterns and problems of solid waste storage, transport, and disposal. Examination of various engineering alternatives with apporpriate consideration for air pollution control, water pollution control, and land reclamation. Analytical approaches to recovery and reuse of materials. (3 s.h.)

234-601 Industrial Wastewater Management - Waste disposal problems of various industries, causing pollution of natural bodies of water, method of treatment, and administrative and regulatory aspects are discussed, with emphasis on biochemical treatment processes. (3 s.h.)

234-608 Advanced Water Treatment & Resources - Analysis of water resources systems, regulation of quantity and quality, water laws and conflicts of objectives. Planning, design and management of water resources systems, modern methods of water treatment. (3 s.h.)

234-609 Environmental Toxicology - Introduction to the mechanisms and impact caused by toxic gases, atmospheric particulate matter, and chemicals in wastewater on biological systems. Experimental models for testing toxicity, mutagenicity, carcinogenicity, and teratogenicity in mammals will be discussed. (3 s.h.)

INSTITUTION: HUNTER COLLEGE

PROGRAM: Environmental Health Science

DEPARTMENT: School of Health Sciences

DEGREE: Bachelor of Science (B.S.)
Master of Science (M.S.)

CONTACT: Dr. George J. Kupchik
Program Director, Environmental Health Science
School of Helath Sciences
Hunter College
105 East 106th Street
New York, New York 10029
(212) 860-1251

PROGRAM DESCRIPTION:

PROGRAM STRUCTURE

Environmental Health Science is a program designed to develop liberally educated health professionals and offers a curriculum requiring humanities, basic sciences, and social sciences, as well as professional studies in environmental health sciences. The graduate program originated in 1970 and the undergraduate program began in 1973.

The B.S. program is junior and senior level and students take their first two years of liberal arts courses at Hunter or another college or university and apply for entrance to the School of Health Sciences in their junior year. This program also has a cooperative education program with the Occupational Safety and Health Administration in which students can alternate between courses and professional work experience. The Master's program offers three concentrations but the student need not specialize. The concentrations are environmental assessment and control, biological response to environmental stress, and environmental health planning and administration.

Laboratory facilities of the School of Health Sciences are available for use by program faculty and students. A computer center is also located within the School.

PROGRAM REQUIREMENTS

Admission to the B.S. program requires the completion of the first two years of a college program with a cumulative index of 2.5 or above and including eight credits of college biology, chemistry, or physics.

The M.S. program generally requires an undergraduate major in science or engineering for admission. Students are expected to have completed a minimum of two years of chemistry, one year of biological sciences, one year of physics, and one semester of college mathematics. The aptitude section of the Graduate Record Exam is also required.

A B.S. degree in Evnironmental Health Science requires a total of one hundred and twenty-eight credits which includes a minimum of forty-five credits in environmental health science courses, thrity-six credits in basic sciences and math, and thirty-four credits in humanities, social sciences and English.

Requirements for the Master's degree includes a minimum of thirty-six credits, including eleven credits in core courses and approximately sixteen to eighteen credits in one of the concentrations: environmental assessment and control, radiological health engineering, or environmental health planning and administration. Also required are a Master's thesis and four to eight credits in field work or laboratory research projects, and a two credit thesis seminar.

CURRENT FACULTY, STUDENTS, GRADUATES

Program faculty consists of three full-time members and four adjunct members each semester. Other faculty of the School of Health Sciences are involved in the program from time to time. Most faculty time is devoted to teaching. Research funding presently consists of one grant from EPA.

There are presently thirty-four undergraduates in the program, all full-time and twenty full-time and thirty-two part-time students in the graduate program. Many students have transferred to the program from other curriculums, particularly biology. General means of recruitment of students for the program has been through newspaper advertising and sending information to other schools. Several students are receiving financial assistance, primarily from Public Health Service training grants. One student is currently receiving a research assistantship.

The B.S. program graduates approximately ten students per year and is steadily increasing. An average of twelve students graduate from the M.S. program each year and this figure is expected to remain stable. Graduates almost always find employment in their field, most with government agencies, but also in private industry, consulting firms, and teaching. Placement of graduates is normally done through informal contacts of the faculty.

PROGRAM PROJECTIONS

Program officials anticipate the development of a concentration in occupational health at the graduate level and additional courses at the undergraduate level. This would consist of several courses and would require at least one additional faculty member. Preliminary approval has already been obtained for two of the proposed new courses.

COURSE DESCRIPTION

(the following is a partial listing of courses)

Undergraduate courses:

38 300 Environmental Measurements Laboratory - Most frequently employed methods of sampling and analysis of environmental media. (3 s.h.)

38 310 Principles of Water Quality Management - Lectures and seminar discussions are designed to develop a basic understanding of the importance of water resources, past development of the field, its current status, and trends for the future. Many current topics including stream pollution, quality requirements, and treatment systems. (3 s.h.)

33 312 Air Pollution Control - Sources, transport phenomena, health effects, and other biological effects and non-biological effects of community air pollutants are studied. (3 s.h.)

33 315 Solid Waste Management - The management, handling and disposal of solid waste from the community, industry and institutions; systems of sanitary landfills, incineration, recycling, and conversion. The public health significance of solid waste management. (3 s.h.)

33 318 Fundamentals of Vector Control - The public health significance of insects and rodents, life cycles, identification, disease transmission, methods of control and the use of insecticidal and rodental agents. (2 s.h.)

33 322 Radiological Health - The physics of ionizing radiations, their interaction with matter, and their effects are discussed. (2 s.h.)

Graduate courses:

IHE 700 Environmental Health and Safety - Chemical, physical, and biological factors influencing the quality of the domestic and industrial environment; air and water pollution; and other topics. (3 s.h.)

IHE 740 Application of Computers to Environmental Problems - Consideration of basic concepts and principles of computers and programming as they are currently employed in the solution of environmental problems. (3 s.h.)

IHE 741 Environmental Monitoring and Direct Instrumental Methods - Quality control monitoring for potentially dangerous constituents on a semi-continuous or continuous basis. Factors influencing reliability of sampling procedures. Instrumental methods for SO_2, NO_2, CO, toxic metals and dust, pesticides, noise. (4 s.h.)

IHE 750 Environmental Physiology - Man's physiological responses to environmental stress factors, e.g., heat and cold, air pollutants, noise, etc. (2 s.h.)

IHE 751 Microbiology: Applications to Environmental Health Problems - A study of environmental microbiology, such as microbiology of food and dairy products, water, sewage, air, etc., using standard and recommended procedures for environmental samples. (3 s.h.)

IHE 754 Environmental and Occupational Toxicology - Toxic chemicals occurring in domestic and occupational environments: aspects of entry to the body, mode of action, metabolism and excretion. Emphasis on in vivo interactions between various toxic chemicals leading to potentiation or antagonism. Laboratory portion of the course includes the methodology of toxicity testing including determination of LD50 on small animals by oral, inhalation and dermal administration; other topics. (4 s.h.)

IHS 744 Industrial and Environmental Noise Problems - Evaluation and control of noise hazards; effects of noise on man; medical-legal aspects of noise-induced hearing impairment. (3 s.h.)

CHE 620 Chemistry of Environmental Pollution - The pollution of the environment classified by its three principal sources, industrial, domestic and agricultural activities discussed in terms of the reaction and physical chemistry of the agents therein produced. (2 s.h.)

URB 708 Environmental Planning - Current and emerging issues in controlling and preventing environmental degradation through air and water pollution, solid wastes, noise, pesticides, radiation, etc. These subjects to be viewed in relation to population growth and trends in energy conversion, materials processing and the recycling of residuals. (3 s.h.)

IHE 720 Environmental Criteria and Standards - An analysis of selected criteria and standards for environmental protection to determine their origin, validity, and feasibility. Students, with faculty guidance, will prepare review documents on specific standards documenting the standard, applicable criteria and assess supporting published data. The review will also evaluate the feasibility and implications for enforcement. (3 s.h.)

INSTITUTION: JOHNS HOPKINS UNIVERSITY

PROGRAM: Environmental Engineering

DEPARTMENT: Department of Geography and Environmental Engineering

DEGREE: Master of Science in Engineering (M.S.E.)
Master of Arts (M.A.)
Master's Program in Systems Analysis and Economics for Public Decision Making
Doctor of Philosophy (Ph.D.)

CONTACT:
Dr. Gordon Wolman
Chairman, Dept. of Geography and Environmental Engineering
Johns Hopkins University
Baltimore, Maryland 21218
(301) 338-7092

PROGRAM DESCRIPTION:

PROGRAM STRUCTURE

Interdisciplinary in structure, the Department of Geography and Environmental Engineering has four different areas of strength. These are: Environmental Engineering; Ecology, Environmental Science, and Surficial Earth Processes; Systems Analysis and Economics for Public Decision Making; and Urban Studies and Spatial Location.

The Environmental Engineering program is concerned with measures to control environmental pollution, to contribute to environmental management, and to protect the public health. The program's aim is to develop the student's understanding of: waste materials contributing to pollution, technology associated with treatment of such wastes, and observation and measurement of the effects of waste on the water environment. The second area, Environmental Science, is based upon the premise that environmental scientists should have knowledge of chemical and biological principles and their interrelationships. Study and research is made available in the areas of aquatic biology, water and atmospheric chemistry, surficial earth processes, biogeography and soil science. The third area is intended to give students skills required today for analysis of public decision making problems, and the final area, Urban Studies and Spatial Location, involves the study of basic social and economic factors influencing regional form.

The department stresses individuality in selecting courses which pertain to the student's special field of interest. Once the fundamentals of the field are mastered, the student has complete freedom to pursue studies in related fields. Independent studies, seminars, workshops and laboratories comprise a vital part of the student's program.

PROGRAM REQUIREMENTS

Students having a sound background in natural, social or engineering sciences with a bachelor's degree in science, arts, engineering, or the equivalent, are admitted to the program. Except for the master's program in Systems Analysis and Economics for Public Decision Making, the master's and doctorate degree programs are not rigidly structured. The Master of Science in Engineering and Master of Arts degrees require one year of formal course work with no more than three quarters in the Department of Geography and Environmental Engineering. Those in the M.A. program and those planning to go onto the doctorate program must acquire reading knowledge of one foreign language. Candidates for these degrees must conduct an independent investigation, submitted in essay form.

Candidates for the master's in Systems Analysis and Economics for Public Decision Making program must take two semesters of full-time course work plus one summer for a master's essay approved by the department. Student's may choose one of two specialty areas emphasizing either systems analysis or economics. The following required courses apply to both areas: Mathematical, and Economic Foundations for Public Decision Making, and Environmental Policy Analysis.

The Ph.D. program requires two full academic years of formal course and seminar work and a minimum of two consecutive semesters as a full-time resident student. Students must be involved in teaching activity in the department for one course equivalent and must acquire reading knowledge in one foreign language of scientific significance. One academic year prior to graduation, students usually take the Graduate Board Oral Examination.

Students receive financial assistance through university fellowships, tuition grants, university assistantships, work study, and research assistantships. The department receives grants from the Ford Foundation, federal, state and local agencies in the environmental field, and private sources. It also receives support from the university, the National Science Foundation, and the National Defense Education Act.

CURRENT FACULTY, STUDENTS, GRADUATES

There are currently eleven full-time faculty members, all devoting time to teaching and research. There is also one part-time lecturer. Research currently being conducted includes an EPA project, a 208 project, and a project for the City of Baltimore.

Thirty-four full-time and four part-time males are enrolled in the program, and nine full-time and three part-time females are currently enrolled.

There are an estimated six to eight graduates each year, but this number fluctuates significantly. Through personal contact, the program finds that only a small fraction of graduates of the master's program go on to further schooling. Of the remaining, 50 percent go into teaching and/or research in engineering, arts and sciences; 40 percent go into technical, administrative and regulatory employment at the federal, state and local level; and 10 percent go into consulting. All of those employed work in their field of preparation.

PROGRAM PROJECTIONS

The department plans to increase the staff by two, in the area of Environmental Engineering over the next five years. The program is trying to restore the balance between the engineering, arts, and sciences sectors of the program. There is no plan to develop new programs, as the demand for graduates of the present program is very high.

The program plans to continue and stress its interdisciplinary structure, though it feels that this structure is not necessarily appropriate for all institutions.

COURSE DESCRIPTION (SELECTED)

38.30 Introduction to Environmental Engineering - The course includes water supply, waste-water treatment, water quality, atmospheric pollution and pollution control, and solid-waste management. (3 s.h.)

38.301 Water and Wastewater - A study of population growth and distribution; water supply requirements and domestic sewage flows; techniques for analyzing rainfall, runoff, fluid flow, reservoir silting and groundwater data; and the application of these techniques to the design of sanitary works. (3 s.h.)

38.302 Water and Waste Treatment - The theory and practice of water purification and waste water treatment, including aeration, chemical coagulation, sedimentation, thickening filtration, biological waste treatment, chlorination, water softening, removal of iron and manganese, solids treatment and disposal and nutrient removal. The influence of stream pollution on the degree of waste treatment required, and criteria for preservation of water quality for various uses are discussed. (3 s.h.)

38.306 The Biology and Ecology of Polluted Waters - This course is intended to provide students with an insight into the biological and responses to polluted waters. (3 s.h.)

38.353 Principles of Hydrology - Examination of the various components of the hydrologic cycle including precipitation, infiltration, runoff, subsurface flow, and evaporation. (3 s.h.)

38.665-666 Seminar in Water Science and Management - These seminars have as their objective the presentation and discussion of the problems associated with the management of water for all purposes, with emphasis on modification or innovations in concepts of use, economic values, administrative controls and political organizational arrangements, as well as presentation of existing and emerging problems of a technical and scientific nature requiring further study and research. (2 s.h.)

38.7 Issues in Environment - Presentation of critical environmental issues by university faculty and others followed by class discussions of the problems and issues.

38.329 The Chemistry and Physics of Water Pollution - A discussion, based on concepts from the natural sciences, of the chemical and physical processes associated with changes of the quality of natural water systems caused by addition of pollutants. (3 s.h.)

38.330 The Chemistry and Physics of Air Pollution - A discussion based on concepts from the natural sciences, of the chemical and physical processes associated with changes in atmospheric quality caused by additions by pollutants. (3 s.h.)

38.366 Physiological Ecology - The physiological response of whole organisms to environmental stresses and the ecological implications of such responses. (3 s.h.)

38.341 Principles of Human Geography - Spatial aspects of human organization with emphasis upon the principles of location theory and their application to social and cultural phenomena. (3 s.h.)

38.619 Urbanization and Environmental Quality - This course will explore the relationships between growth, urbanization and environmental quality. (3 s.h.)

38.358 Resource Management and Conservation - A theoretical and empirical analysis of the economic concepts pertaining to the development, use, and conservation of natural resources. (3 s.h.)

38.359 Environmental Policy Analysis - This course focuses on current issues of environmental management, but in so doing explores the problems of making choices about environmental quality and the management of common property resources in the American economic and political system. (3 s.h.)

38.603 Water Resources Systems Engineering - This course will consider descriptive and optimization-oriented water quantity models. Topics include simulation of reservoir operation; optimal operation and sizing of reservoirs in series and parallel; and many others. (3 s.h.)

INSTITUTION: KANSAS STATE UNIVERSITY (KSU)

PROGRAM: Chemical Engineering

DEPARTMENT: Chemical Engineering

DEGREE: Bachelor of Science in Chemical Engineering (B.S.)
Master of Science in Chemical Engineering (M.S.)
Doctorate in Chemical Engineering (Ph.D.)

CONTACT: Dr. L. T. Fan, Head
Department of Chemical Engineering
Kansas State University
Durland Hall
Manhattan, Kansas 66506

PROGRAM DESCRIPTION:

PROGRAM STRUCTURE

The Department of Chemical Engineering at Kansas State University awards three major degrees--B.S., M.S., and Ph.D. The curriculum offers a broad, fundamental background in chemical engineering science and application to undergraduates, who can also emphasize areas such as chemistry, mathematics, material science, management, computer science, and bioengineering. Graduate students pursue research interests utilizing well-equipped laboratories in transport phenomena, reaction engineering, thermodynamics, biochemical and biomedical engineering, process dynamics and control, and food engineering. The department has shop facilities in which unusual equipment is built and repaired, and the College of Engineering and university computer centers are used extensively.

Research support has come from the National Science Foundation, U.S. Department of Agriculture, U.S. Air Force, Energy Research and Development Administration (now Department of Energy), Environmental Protection Agency, National Institute of Health, and the university's Engineering Experiment Station as well as private sources. The faculty publish actively, and the department is currently engaged in cooperative research projects with Yamanashi University (Japan) and the U.S.S.R.

PROGRAM REQUIREMENTS

Undergraduates must complete 134 semester hours for graduation with a B.S. in Chemical Engineering. Admission to the KSU Graduate School in full-standing requires that the applicant have 1) a bachelor's degree from an approved institution, 2) adequate undergraduate preparation in the proposed major field or equivalent evidence of an advanced background for undertaking an advanced degree program, and 3) an undergraduate average of B or better in the junior and senior years.

CURRENT FACULTY, STUDENTS, GRADUATES

Of the eleven staff members in the department, ten occupy teaching positions though all devote some time to research (30-40 percent); one person is a full-time researcher. Faculty salaries are supplemented by outside sources during the summer months (grants, appointments in other departments). Of the ten Ph.D. and twelve M.S. students, approximately 90 percent are male. Numbers of graduates annually remain stable (two Ph.D., four M.S.); and although KSU's enrollment is increasing rapidly, the Chemical Engineering Department does not seek to expand drastically and beyond its capacity.

Graduates are traced annually through a departmental newsletter, and computerized lists (by employer and location) are maintained. During their careers, chemical engineers can expect to participate in many decisions crucial to the preservation and improvement of society, especially in the areas of energy and food production, resource management, and the specification and design of pollution control processes. Employment opportunities exist in the chemical, petroleum, pharmaceutical, plastics, paper, and food processing industries, as well as government service. Virtually all students completing degrees in this program are employed as chemical engineers (60 percent in the private sector, 10 percent in government, 20% in teaching).

Following a "no assist, no admit" policy at the graduate level, all M.S. and Ph.D. students are supported by state monies or grants ($400-500/mo).

PROGRAM PROJECTIONS

Due to student enrollment growth in the past several years, the Department of Chemical Engineering expects to add one or two general curriculum faculty members in the next two years. No major curriculum developments are projected, in part because the existing course structure is flexible enough to adapt to new techniques in chemistry when they are developed. Students are given basic principles and technological skills which are generally useful even as the profession changes.

COURSE DESCRIPTION

Undergraduate and Graduate courses in minor field:

520 531 Transport Phenomena I - A unified treatment of the basic principles of momentum, energy and mass transport. (3 s.h.)

520 531 Transport Phenomena II - Continuation of Transport Phenomena I with special emphasis on mass transfer. (3 s.h.)

520 550 Chemical Reaction Engineering - Applied chemical kinetics and catalysis including the analysis and design of tubular, packed bed, stirred tank and fluidized bed chemical reactors. (3 s.h.

520 561 Chemical Process Dynamics & Control - A study of the unsteady state behavior of chemical processes, modeling and simulation of chemical processes, classical control theory and design. (3 s.h.)

520 570 Ch.E. Systems Design I - Basic Concepts of optimization and process economics with application to the design of chemical processes. (3 s.h.)

520 571 Ch.E. Systems Design II - The synthesis and design of chemical processing systems. Emphasis will be placed on the solution of comprehensive systems design problems. (3 s.h.)

Undergraduate and graduate courses:

520 715 Biochemical Engineering - The analysis and design of biochemical processing systems with emphasis on fermentation kinetics, continuous fermentations, aeration, agitation, scale up, sterilization, and control. (3 s.h.)

520 725 Biotransport Phenomena - Principles of transport phenomena applied to biological and physiological processes. Membrane transport processes, circulatory system transport phenomena, transport and distribution of drugs. (3 s.h.)

520 805 Selected Topics in Biochemical Engineering - Subjects of current interest in the broadest sense of biochemical engineering. These involve not only chemical engineering problems which contain biochemical, biological or medical elements but also application of chemical engineering principles and methodologies to biochemical, biological, medical and ecological problems. (3 s.h.)

Graduate courses:

520 822 Advanced Chemical Reaction Engineering - Theory of kinetics and catalysis in homogeneous and heterogeneous systems, with application in chemical reactor design and process development. (3 s.h.)

520 826 Advanced study of mass transfer operations. (3 s.h.)

520 850 Advanced Chemical Process Dynamics - The dynamical behavior of chemical reaction systems and process equipment used in chemical plants. Control mechanisms for these systems. (3 s.h.)

520 862 Advanced Transport Phenomena I - Advanced treatment of momentum, energy and mass transport, with emphasis on momentum transport in chemical engineering applications. (3 s.h.)

520 867 Advanced Transport Phenomena II - Advanced treatment of momentum, energy and mass transport, with emphasis on energy and mass transport in chemical engineering applications. (3 s.h.)

520 871 Advanced Process Design and Optimization - Advanced problems in the optimal design and economic evaluation of plant equipment and processes for the chemical and allied industries. (3 s.h.)

520 910 Selected Topics in Transport Phenomena - Subjects of current interest such as surface phenomena, turbulent transport, droplet mechanics, multi-component systems. (3 s.h.)

520 915 Selected Topics in Process Dynamics - Study of the most recent methods for analysis of the dynamic behavior and control of complex systems and industrial processes. The use of Lyupanov theorems and the maximum principle are examples of the methods to be studied. (3 s.h.)

520 920 Selected Topics in Unit Operations - Study of topics as zone melting, foam fractionation, membrane permeation, thermal diffusion, and unsteady state operations. (3 s.h.)

520 925 Selected Topics in Process Design and Optimization - Study of advanced methods of process design and optimization, such as modern variational methods and dynamic programming. Applications to be chosen mainly from the chemical and allied industries to include stochastic as well as deterministic problems. (3 s.h.)

INSTITUTION: KANSAS STATE UNIVERSITY (KSU)

PROGRAM: Institute of Environmental Research

DEPARTMENT:

DEGREE: None awarded

CONTACT: Dr. Frederick H. Rohles, Director
Institute for Environmental Research
Kansas State University
Manhattan, Kansas 66506
(913) 532-5620

PROGRAM DESCRIPTION:

PROGRAM STRUCTURE

With the donation of the Environmental Chamber from the American Society of Heating, Refrigerating, and Air conditioning Engineering (ASHRAE) which was located in Cleveland, Ohio, and the completion of facilities to house this valuable equipment, the Institute for Environmental Research was dedicated in 1963. Initially, the major research thrust at the Institute was in the area of thermal comfort. Since then, however, the purposes have expanded and can be summarized as follows: (1) to study the effects of altered environments on physiology, health, comfort, learned and innate behavior, and affectivity and comfort; (2) to conduct air pollution and fine particle research relative to health and comfort; (3) to conduct research in bio-medical engineering; and (4) to provide the staff and facilities for graduate training in bio-environmental engineering.

Institute facilities and staff are used for university-wide research programs, graduate student thesis research, and private and governmental programs sponsored by agencies. Areas of research expertise include all aspects related to the interaction of man and his thermal environment (thermal comfort, humidification, air movement, clothing, physical activity, heat stress, and personal protection; fine particle technology, particularly that related to air contamination and air pollution control; modeling; foods and nutrition; comfort in the elderly; health in school children; energy conservation; and environmental requirements for laboratory animals.

Institute personnel maintain that research must be application of science and concentrated on human factors. Centered around the concerns regarding our energy use and conservation practices, the Institute cooperates with manufacturers of outdoor and wilderness materials to evaluate the durability and utility of their products under stressful conditions. Major research funding has also come from Ford Motor Company, ASHRAE, National Institute of Health (National Institute of Occupational Safety and Health), 3M Center, U.S. Air Force, The Northface, Coleman Company, Biolet and the university's Engineering Experiment Station.

The Environmental Chamber--one of three in the world--measures 12' x 24' with an adjustable ceiling of eight to eleven feet. Studies of air temperature and mean radiant temperature can be investigated independently, and complete instrumentation measures surface and air temperatures and automatically controls all room variables. In addition to the chamber, KSU has four walk-in climatic control rooms and an isolation facility providing temperature, humidity, sound, and light control capabilities; several Digitec Automatic Data Acquisition Systems, a Brookline Metabolic Scale, Collin Treadmill, Physiologic Monitoring equipment, an electrically heated copper manikin (only non-government one owned), and a guarded hot-cold plate built by KSU as specified by the American Society of Testing Laboratories to assess heat transfers of materials (insulation, carpets). In the Fine Particle-Air Pollution Laboratory, equipment includes a 40-foot wind tunnel, 10' x 12' test kitchen for range hood testing, and a vacuum cleaner test area.

PROGRAM REQUIREMENTS

(not applicable)

CURRENT FACULTY, STUDENTS, GRADUATES

Since its inception in 1963, over thirty-five faculty members from various KSU departments have utilized the Institute facilities. The director of the Institute serves as its sole full-time staff member with 70 percent of his time devoted to research and 30 percent devoted to teaching. At any one time, approximately ten students are engaged in research projects (75 percent undergraduates) independently or with faculty members; these students may receive some financial renumeration from available grant monies.

PROGRAM PROJECTIONS

Though KSU's Institute for Environmental Research provides an excellent interdisciplinary training ground for students interested in research and opportunities for sophisticated study by faculty members on man's internal environmental system, continued financial support is critical if the program is to expand. Already the decline in available monies has necessitated a decline in research activity at the Institute.

INSTITUTION: KANSAS STATE UNIVERSITY (KSU)

PROGRAM: Mechanical Engineering

DEPARTMENT: Mechanical Engineering

DEGREE: Bachelor of Science in Mechanical Engineering (B.S.)
Master of Science in Mechanical Engineering (M.S.)
Doctorate in Mechanical Engineering (Ph.D.)

CONTACT: Dr. Paul L. Miller, Head
Department of Mechanical Engineering
Kansas State University
E108 Seaton Hall
Manhattan, Kansas 66506
(913) 532-5610

PROGRAM DESCRIPTION:

PROGRAM STRUCTURE

Kansas State University's Department of Mechanical Engineering offers undergraduate and graduate degrees in a program emphasizing technical expertise in a wide range of environmental areas. According to a recent catalogue, graduates work in pollution control, computers, food supply and processing, communication systems, power generation and distribution, petroleum location and production, aircraft, environmental control, transportation, construction, atomic energy, etc.

The curriculum is designed to prepare students for this broad occupational range. Undergraduates take engineering science courses in the sophomore and junior years and engineering application courses in the junior and senior years. Laboratory, humanistic, and social science courses complement the engineering core. The B.S. sequence culminates in a senior design laboratory where teams of three to five students each work on an authentic engineering problem supplied by an industrial sponsor. Considerations of cost, social impact, economics, product life, and the like are usually involved, as well as the technical solution of the problem. At the end of the project, a written report is prepared and a verbal presentation made to engineers and officials of the sponsoring company. Frequently a working model is fabricated and demonstrated.

Students pursuing graduate study can elect advanced work and research in the following areas: heat transfer, thermodynamics, air conditioning, energy conversion, automatic control, fluid/gas dynamics, aerodynamics, environmental engineering, biomedical engineering, propulsion systems, engineering design, kinematics and vibrations.

The Department of Mechanical Engineering boasts of separate well-equipped laboratories in air diffusion, fluid controls, fine particle technology, instrumentation, thermal sciences, and vibrations. Graduate students also have access to the university digital and analog computers and the various engineering laboratories and shops.

In the past two years, the Department of Mechanical Engineering has experienced a ten-fold increase in research funding received. In addition to some miscellaneous sources, monies have been received from the National Science Foundation; National Bureau of Standards; American Society of Heating, Refrigerating, and Air Conditioning Engineers; 3M Center; National Institute of Health; the university's Engineering Experiment Station; and Christiansen Diamond Products Company. Research grants in force in July, 1977, were for $236,000.

PROGRAM REQUIREMENTS

Residents of Kansas who graduate from an accredited Kansas high school are admitted to Kansas State University. Out-of-state applicants are expected to have a strong academic rank in class and to have made good scores on the American College Test battery.

To complete Kansas State's undergraduate program in Mechanical Engineering, a student must take 133 semester hours (see program structure). Students enrolling in an M.S. or Ph.D. program who have received the B.S. or M.S. degree in Mechanical Engineering from a school which does not have an Engineers' Council for Professional Development accredited curriculum in Mechanical Engineering are required to take a qualifying examination in several major areas (thermodynamics, differential equations, dynamics, and heat transfer) or in lieu of the examination, take the appropriate undergraduate course for credit.

The M.S. degree candidate may choose from three options: 1) minimum of 30 semester hours including a thesis of 6-8 semester hours, 2) minimum of 32 semester hours including a report of 2 semester hours of research or of problem work on a topic in the major field, or 3) minimum of 33 semester hours including evidence of scholarly effort.

To complete the Ph.D., a minimum of 90 semester hours beyond the B.S. degree are required. An M.S. degree is required for entrance into the doctoral program; and foreign language proficiency and several major examinations (oral and written) are to be completed prior to admittance to candidacy in the Ph.D. program.

CURRENT FACULTY, STUDENTS, GRADUATES

Of the 16.3 faculty lines assigned to the Department of Mechanical Engineering, 14.6 of the time allotted to those lines is given to teaching and 1.7 to research. No faculty member has more than 20 percent of his/her time funded by research. Faculty members serve approximately 276 undergraduate majors, 13 M.S. and 7 Ph.D. full-time students, and 4 M.S. and 4 Ph.D. part-time students. The number of graduates annually from all three degree levels is relatively stable (50 B.S., 10 M.S., 2 Ph.D); recently, however, the department experienced an abrupt fluctuation with a 65 percent increase in enrollment over the last four years.

Graduates are usually traced through Alumni Association records; but a project "Epilog" sponsored in conjunction with the American Society for Engineering Education is following graduates of KSU's program for three years upon completion of their degrees.

Financial support for undergraduates, in addition to standard loan programs, is minimal and administered through endowment funds of the department. Ten graduate students receive state support and five more are funded through current research projects. All graduate students are currently on some type of assistantship ($350/mo) unless they are financed by their own governments.

Faculty perceptions are that virtually all students obtain employment in their field of training. According to KSU personnel contacted in Mechanical Engineering, the Mechanical Engineering degree "sells" better than a more specific option (e.g., petroleum engineering). Approximately 144 companies interview on campus each semester.

PROGRAM PROJECTIONS

The program in Mechanical Engineering has been on the Kansas State campus since the early 1900s and gained accreditation at the B.S. level in 1936. With enrollment and research monies increasing, three additional faculty members are expected to be added over the next three years in thermal science, machine design, and automatic controls. Given the department's commitment to basic mechanical engineering degrees, no major curriculum changes are forecast.

COURSE DESCRIPTION

Undergraduate and Graduate courses:

560 527 Heat Transfer - Fundamentals of conduction, convection, and radiation; principles of heat exchanger design and dimensional analysis. (3 s.h.)

560 560 Engineering Economics - Economic analysis of problems as applied in engineering. (3 s.h.)

560 575 Mechanical Engineering Design Laboratory - Application of the principles of the design process in the solution of engineering industrial-type problems with direct involvement of industry. (2 s.h.)

560 662 Environmental Engineering I - Psychrometry; heating-cooling system design; air quality measurement and control; effect of air pollution. (3 s.h.)

560 625 The Man-Environment System - Basic structure and performance of the human, viewed as a component in information processing and control systems. Effect of visual, auditory, and thermal environments. (3 s.h.)

560 719 Engineering Acoustics I - A study of elementary engineering acoustics and its application to the measurement and control of sound and noise, including laboratory exericises. (3 s.h.)

560 722 Environmental Engineering II - Study and analysis of environmental factors and man's response to these factors; air pollution, air cleaning, biological heat transfer; factors affecting comfort, health, learning, and productivity. (3 s.h.)

560 742 Fine Particle Technology - Definition, theory, and measurement of particle properties, particle dynamics, size distribution and characteristics of powders encountered in particle transport, gas cleaning, air pollution sampling and particle processing; the physics of air ion generation, transport and decay; and requisites of accurate sampling of air-borne contaminants. (3 s.h.)

560 819 Engineering Acoustics II - A study of the generation, propagation, and reproduction of sound, with applications to the transmission and reduction of sound in materials and structures, and the design of acoustic enclosures and filters. (3 s.h.)

Graduate courses:

560 850 Advanced Power Plant Engineering - An advanced course in the economic problems in the design of power plants and in the generation of power, selection of equipment, choice of station heat balance, generation of by-product power in industries, and interconnections between utilities and industrial plants for the economical interchange of power. (variable s.h.)

560 916 Advanced Topics in Mechanical Engineering - A course reserved for study of current topics in Mechanical Engineering. Particular subject areas which may be included are: air conditioning, automatic controls, biomedical engineering, energy conversion, engineering design, environmental engineering fluid and gas dynamics, heat transfer, kinematics, thermodynamics and vibrations. (variable s.h.)

560 943 Radiation Heat Transfer - Basic theories of thermal radiation, shape factors; exact and approximate solutions of integral equations for radiation heat transfer between solid surfaces with absorbing or non-absorbing medium. (3 s.h.)

INSTITUTION: KIRKWOOD COMMUNITY COLLEGE (KCC)

PROGRAM: Environmental Health Assistant
Environmental Health Technician
DEPARTMENT: Environmental Science and Pollution Control
DEGREE: Diploma (Environmental Health Assistant)
Associate of Arts [A.A.] (Environmental Health Technician)

CONTACT: Larry Willis, Career Education
Linn Hall
Kirkwood Community College
Cedar Rapids, Iowa 52406
(319) 398-5498

PROGRAM DESCRIPTION:

PROGRAM STRUCTURE

This program began in 1968 and trains people to monitor and enforce health standards and codes in order to safeguard the public health. This function is required by each of the 99 counties in Iowa. Other positions could be with city and county boards of health, housing improvement agencies, private industries, state environmental quality departments, state departments of agriculture, private laboratories.

PROGRAM REQUIREMENTS

For admission, a copy of the high school diploma is required along with an official transcript of each college or university attended.

Environmental Health Assistant requires 53 quarter hours, 19 related hours, and 4 quarters to complete. Environmental Health Technician requires 71 quarter hours, 46 related hours and 6 quarters to complete.

Related courses include chemistry, algebra, microbiology, physics, communication skills, government, and psychology.

CURRENT FACULTY, STUDENTS, GRADUATES

Faculty consists of one instructor and one coordinator. Fourteen students are enrolled in the assistant's program and five in the technician's program. There were eight and five graduates respectively (yearly).

Graduates receive employment in local health departments, departments of agriculture, and state health departments as technicians. Some graduates (25 percent) receive further training, usually leading to a Bachelor of Science degree.

PROGRAM PROJECTIONS

Program modifications are in the planning stages. A new focus will be geared to business, government and industry, attracting a new type of student and to help the attrition rate. The program is being designed for more flexibility. The new emphasis will include more courses to choose from and a variety of options.

ADDITIONAL INFORMATION

An advisory committee consists of 17 people. These men are located in the field and are often directors of county health departments.

In the past, training modules have been developed for business, industry, the Comprehensive Employment Training Act (CETA), and the Manpower Development Training Act (MDTA) pertaining to occupational health and safety. This has been in response to the changing needs of government, business, industry and the need for continual up-date of information for those in the field.

COURSE DESCRIPTION

EV004U Introduction to Environmental Health - Offers an overview of the organized community effort to overcome disease and upgrade the level of health of the public. (3 q.h.)

EV015U Insect and Rodent Control - Includes the identification of insect and rodent pests, how they spread disease, and the control procedures with special attention to sanitary practices and the judicious use of insecticides. (3 q.h.)

EV012U Private Wastewater Systems - Emphasizes small water - borne wastewater disposal systems. Design and evaluation of such systems to include systems in tight soils. (5 q.h.)

EV016U Private Water Systems - Considers source and protection of private water supplies. Also considers water quality, sanitary survey and water sampling, bacterial and chemical examinations of water. (5 q.h.)

EV013U Supervised Field Studies - Offers supervised on-the-job training in inspection procedures, complaint investigations, food, water and milk sampling, report writing, and administration in a typical work environment. (10 q.h.)

EV014U Seminar: Environmental Health - Studies problems encountered during field learning experience. (2 q.h.)

EV018U Air Quality Management - Considers the sources of air pollution, the classification of pollutants, the meteorological aspects, the effects of atmospheric pollution, the prevention/control of air pollution, and monitoring of pollutants. (4 q.h.)

EV017U Environmental Health Administration - Includes such topics as governmental aspects of public health, legal considerations, organizational considerations, personnel factors, fiscal management, and public relations. (4 q.h.)

EV019U Radiation Control - Covers fundamentals of radiation, biological effects of radiation, types of X-ray units, common hazards, radioactive sources, radiation protection, disposal of radioactive wastes, and environmental radiation surveillance and monitoring. (3 q.h.)

EV007U Milk Sanitation - Includes the quality milk program; the sanitation involved in the production and the processing of milk; and proper sampling technique. (5 q.h.)

EV006U Food Sanitation - Includes the relationship of food and the preparation and handling of food to the health of the public, and sanitary requirements of food handling establishments. (4 q.h.)

EV008U Occupational Health and Industrial Safety - Includes routine monitoring of safety, health and hygiene conditions in the work place, controlling work practice and working conditions, writing necessary reports, and recommending appropriate action. (4 q.h.)

EV009U Recreational Sanitation - Covers the health and safety aspects of parks, trailer parks and swimming pools including regulation enforcement and testing. (4 q.h.)

EV010U Solid Waste Management - Covers the character of solid waste produced by households and communities; their health and nuisance significance; and proper methods of disposal including use of landfills, incinerators, and grinders. The hazard of hog feeding and the air pollution and vermin problems associated with refuse burning and dumps also will be covered. (5 q.h.)

EV005U Institutional Sanitation - Covers environmental factors involved in the health and safety considerations in schools, nursing homes, hospitals and correctional institutions. (3 q.h.)

EV003U Public Water Systems - Considers operation and evaluation of public water supply and treatment system. (4 q.h.)

EV002U Public Wastewater Systems - Considers the operation and evaluation of public wastewater treatment systems. (4 q.h.)

INSTITUTION: LAMAR UNIVERSITY

PROGRAM: Environmental Science

DEPARTMENT: Interdisciplinary

DEGREE: Bachelor of Science (B.S.), Master of Science (M.S.) in Environmental Science

CONTACT: Dr. Ewin A. Eads
Director of Environmental Studies
P.O. Box 10208
Beaumont, Texas 77710
(713) 838-7320

PROGRAM DESCRIPTION:

PROGRAM STRUCTURE

Approved in 1964, the B.S. degree program in environmental science at Lamar trains students to implement the current laws and their regulations which control the quality of the environment. Specifically, studies emphasize all sources of air emission and wastewater discharges, controlled by these regulations.

The program is interdisciplinary in nature with a strong emphasis in biology, chemistry and civil engineering. Courses in general biology, microbiology, ecology, parasitology and limnology, general analytical, organic and physical chemistry are offered. Graduates of the program find employment opportunities in industrial and domestic air and water pollution, environmental planning, water/wastewater treatment research, management of air and water resources or occupational health fields.

Although the program has definite requirements, students are allowed great flexibility in the design of curricula. A unique feature about the environmental studies program at Lamar is the generation of funds by the students. Through industry and private foundations, over $25,000 for student support is received annually, in the form of research and training grants. However, federal support of the program is almost nonexistant.

PROGRAM REQUIREMENTS

High school graduates who have met the university requirements may major in environmental science. Students are required to complete 24 units in biology, 34 units of chemistry, 15 units of English, 15 units of math, eight units of physics, six units in government, six units in civil engineering, two units in physical education, three units of open electives and six units of chemistry electives, plus six units of biology or civil engineering electives. Internships are not required but strongly encouraged. Juniors and seniors have the opportunity to participate with industry in the areas of water and wastewater treatment and/or analysis and air pollution control. The majority of students in the program participate in the intern program at some point in their training.

CURRENT FACULTY, STUDENTS, GRADUATES

The current number of faculty involved in the program is 10. Each one is a member of one of the departments at the university and salaried from their respective departments. Only the Chairman of the Environmental Science program is cost-centered.

Enrollment in the program is steadily increasing. Currently, there are 125 students enrolled. Many of the students carry double majors, i.e., they major in chemistry and environmental studies. The program attracts a large number of career change students from engineering, chemistry, biology and pharmacy. Enrollment in the program is average compared to the rest of the science department. The average number of graduates ranges from 12 to 20 per year.

Approximately 5% of the students continue for a M.S. degree. The students that seek employment have no problem securing jobs in their field. Virtually 100% of the students have jobs on graduation, with 90% going to the private sector and 10% to government.

PROGRAM PROJECTIONS

At present, there are plans to expand the Bachelor's program in the food service and public health sectors. The M.S. program in environmental science will be expanded and eventually Lamar will offer a Ph.D. program in environmental science.

The number of faculty is expected to increase in the next three years with two Ph.D.s needed in the area of air resources and one Ph.D. with expertise in water quality. Lamar also offers seminars every semester for local wastewater operators. These types of programs are also expected to increase depending upon forthcoming funding.

COURSE DESCRIPTION

Chm 130 Introductory Environmental Science - Fundamental concepts of environmental systems as related to urban affairs and man's environment. Air, water and soil pollution with control methods related to the modern technological society. (4 s.h.)

Chm 241 Quantitative Analysis - Theory and practice of analytical chemistry, utilizing gravimetric and titrimetric techniques. (4 s.h.

Chm 333 Inorganic - Generalization involving atomic and nuclear theory; properties of the elements; non-aqueous solvents, acids, bases, oxidation-reduction, etc. (3 s.h.)

Chm 334 Air Analysis - Theory and practice of chemistry as required in determination of ambient air quality. (3 s.h.)

Chm 341 Organic - Current theories and chemical principles as they relate to the field of structure and reaction of the various types of organic compounds. (4 s.h.)

Chm 410 Seminar in Environmental Science - Reports and assigned reading. (1 s.h.)

Chm 434 Air Pollution Surveys - Chemical, physical, meterological, biological, bacteriological and epidemiological factors as applied to determine the extent of environmental damage from air pollution. (3 s.h.)

Chm 438 Radiochemistry - Basic concepts of nuclear science. Principles and use of radiation measuring devices. (3 s.h.)

CE 331 Environmental Science - Introduction to the hydrologic cycle and the chemistry and microbiology of the natural aquatic environment, with emphasis on the physical, chemical, and biological aspects of water and wastewater systems in relation to man's environment. Laboratory work in the physical, chemical, and biological analysis of water and wastewater. (3 s.h.)

CE 433 Environmental Health Engineering - Problems of public health in rural, urban, and industrial centers with water, housing, heating, cooling, ventilation, milk, food, insects and rodents. Bio-statistics and public health laws, ordinances, and regulations. (3 s.h.)

INSTITUTION: McNEESE STATE UNIVERSITY

PROGRAM: Environmental Science

DEPARTMENT: Microbiology

DEGREE: Bachelor of Science (B.S.), Master of Science (M.S.) in Environmental Science

CONTACT: Dr. Victor Monsour
Chairman, Department of Microbiology
McNeese State University
Lake Charles, Louisiana 70609
(319) 477-2520 x 281

PROGRAM DESCRIPTION:

PROGRAM STRUCTURE

The environmental science programs at McNeese State University are administered by the Department of Microbiology. Two degree options are available: the Bachelor of Science and the Master of Science degrees in environmental science. The baccalaureate program was instituted in 1967 with a total of four students in the first class. The master's degree program was organized and established in 1971 with a total of 25 students in the first graduate class.

Although the programs are administered and conducted through the auspices of the Department of Microbiology, the emphasis is on an integrated approach to the problems of pollution control and abatement. Other department, therefore, contribute to the overall structure. Agriculture, chemistry, social science, biology and engineering cooperate in an effort to impart a broad-based science background to the students. The major area of study, however, is microbiology and its applications to the problems and solutions of environmental pollution.

Extensive research opportunities in microbiology are available to faculty and students. Current research activities, in part, include topics such as: biological deammonification; resource recovery from solid waste; nitrate content of airborne particulates; and, subterranean saline intrusion resulting from removal of ground water for irrigation and industrial purposes. Selected students are offered opportunities to assist with projects of these types.

Although the program does not attract adult career-change students, the program does attract program-change students from the areas of engineering, biology and education. A wide variety of students apply for admission to the program. Approximately 15 to 20 U.S. students and an equal number of foreign students, seek admission annually, especially at the graduate level.

PROGRAM REQUIREMENTS

Admission to McNeese State University is granted pursuant to the requirements of the university. In the case of graduate students, admission by the university must be followed by acceptance at the departmental level.

The Bachelor of Science degree is awarded to those students who successfully complete the general academic requirements of the university and also fulfill departmental requirements.

The environmental science baccalaureate student will complete 127 semester hours, 66 of which are lower division. Included in the lower division program is: ES 101, 102, 201, and 202; 22 semester hours of English, social studies and general electives; 24 semester hours of chemistry, microbiology and biology; and, eight semester hours of mathematics.

In the upper division, students are required to successfully complete the following: 20 semester hours of chemistry, microbiology, nuclear science, biology and physics; 19 semester hours of electives, psychology and sociology; 19 semester hours of environmental science; and, three semester hours of biostatistics.

The Master of Science degree includes the following requirements: 16 semester hours of microbiology and environmental science; eight semester hours of microbiology and environmental sciences; eight semester hours in microbiology and approved related fields; and, six semester hours for the thesis. The environmental science student may substitute 12 semester hours of approved environmental science courses for the thesis requirement. The total required semester hours of course work including thesis is 30, and without thesis 36.

CURRENT FACULTY, STUDENTS, GRADUATES

The current faculty complement for the environmental science programs includes five full-time, cost-centered personnel. In addition, there are two part-time faculty members (one attorney, and one public health official) who assist with the teaching requirements of the regular faculty. The department also utilizes the expertise of four graduate research assistants.

At present, there are 17 male and six female full-time students, and four part-time students, enrolled in the baccalaureate program. The master's level enrollment currently includes 22 full-time graduate students, of which approximately 82% are male.

The number of students awarded degrees from the environmental science programs has remained relatively stable over the last few years. On the average, approximately 10 per year earn the Bachelor of Science degree, while approximately seven are annually awarded the Master of Science degree.

Each year an average of 8% of the baccalaureate students elect to pursue the master's degree. Texas A & M, the University of Texas and the University of Mississippi are several of the schools which are the receipients of these graduates. Of the master's level students, approximately 14% annually choose to continue their education at the doctoral level.

Those students who choose a career path upon completion of their studies, find employment in the private sector. Employment opportunities are available to these graduates in the environmental pollution control and abatement areas of air, water, energy, and solid waste. A broad spectrum of occupations usually attracts these graduates.

PROGRAM PROJECTIONS

The programs at McNeese State University have become stabilized in regard to faculty, students and course offerings. The baccalaureate program is anticipated to illustrate some growth over the next few years. The graduate program is not expected to change significantly, however, in any of these respects.

COURSE DESCRIPTION

Undergraduate courses:

ES 101 General Environmental Science - An introduction to the relationship of man's environment to his health. (3 s.h.)

ES 102 General Environmental Science - A continuation of the study of the relationship of man's environment to his health. (3 s.h.)

ES 201 Physical Pollution - An introduction to the major categories of physical pollution of our environment. (2 s.h.)

ES 212 Water and Wastewater - A study of the role of microorganisms in water and wastewater. (4 s.h.)

ES 301 Microbiology of Foods - A study of microorganisms in natural and processed foods; their origin, nature, and effects on foods and the consumer. Federal regulations on processing and packaging are included. (4 s.h.)

ES 321 Consumer Product Protection - Consumer protection relating to current problems including food additives, automobile safety, flammable fabrics, hazardous toys, and misleading advertising. (3 s.h.)

ES 361 Ecology - A study of the ecologic principles as they apply to microorganisms and their environments. Discussions include such phenomena as antagonism, commensalism, symbiosis, and parasitism. (4 s.h.)

Graduate and approved for graduate study courses:

ES 401 Solid Waste Disposal - An introductory course dealing with the types of solid wastes and the current methods for their disposal. (2 s.h.)

ES 411 Ocean Pollution - A detailed study of the various ways in which ocean pollution occurs and how it can affect man and his ecologic environment. (3 s.h.)

ES 421 Air Pollution - An introductory study of the various groups of air pollutants. Methods of field sampling and laboratory testing are included. (4 s.h.)

ES 431 Field Study - Advanced students will visit various installations with a registered sanitarian on routine inspection tipes. May be repeated once for credit. (3 s.h.)

ES 441 Environmental Toxicology - The effects of selected environmental toxicants upon the health of humans. (3 s.h.)

ES 451 Environmental Impact Statements - Previously approved environmental statements are analyzed in detail for content, format, and legal implications. Students are given hypothetical design projects for which impact statements are to be written. (2 s.h.)

ES 461 Aquatic Chemical Processes - A detailed introduction to the physical and chemical processes affecting the distribution and circulation of chemical substances in natural and polluted waters and to the processes involved in water treatment. (3 s.h.)

ES 471 Problems - The advanced student is assigned a research problem in the field. This course may be repeated but one may not accrue more than 6 sem. hrs. of credit toward his degree. (1-3 s.h.)

ES 481 Seminar - Students are assigned topics for formal classroom presentation. This course is required for graduation by all environmental science majors. A student may not accrue more than 3 sem. hrs. of credit toward the degree. (1 s.h.)

ES 494 Environmental Laws - An introductory course in the laws concerning environmental protection. Prerequisites: Senior standing and permission of head of department. (3 s.h.)

ES 501 Solid Waste - A detailed study of the types of solid wastes and the mechanisms for their disposal. (3 s.h.)

ES 502-503 Environmental Science - A study of man's relationship to his environments as the atmosphere, biosphere, hydrosphere, and lithosphere. (3 s.h. each)

ES 511 Air Pollution - A study of the various types of pollutants being discharged into the atmosphere and the mechanisms for their control. (4 s.h.)

ES 521 Stream Pollution - Chemical - A study of the various groups of chemical pollutants and the mechanisms for their control. (4 s.h.)

ES 541 Physical Pollution - A study of the mechanisms for creating and controlling physical pollution of our environment. (2 s.h.)

INSTITUTION: MASSACHUSETTS INSTITUTE OF TECHNOLOGY

PROGRAM: Environmental Engineering

DEPARTMENT: Interdepartmental

DEGREE: Environmental Engineer (Env.E.)

CONTACT: Dr. Peter S. Eagleson
Chairman, Interdepartmental Environmental
Engineer Degree Committee
School of Engineering
Massachusetts Institute of Technology
Cambridge, Massachusetts 02139
(617) 253-2725

PROGRAM DESCRIPTION:

PROGRAM STRUCTURE

Environmental engineering at MIT is an interdisciplinary program administered by the School of Engineering and composed of faculty from the various engineering departments and from other relevant departments throughout the Institute. The program was initiated in 1973 and provides preparation in an environmentally related area of engineering and a background in the relevant area of social science, management, and law.

The degree of Environmental Engineer is a professional degree which goes beyond the Master's level but does not have the research emphasis of the doctorate. Students entering this program normally register in one of the engineering departments and plan their own programs of study which must be approved by a faculty advisor. Research facilities of the various engineering departments are used in support of the program.

PROGRAM REQUIREMENTS

Admission to the environmental engineering program is available by registering in any of the departments in the School of Engineering. General admission requirements include a bachelor's degree or equivalent from an acceptable college, university, or technical school with demonstration of an ability to accomplish a program of study and research.

The Environmental Engineer degree requires the completion of one hundred and sixty-two subject units. This includes sixty-six units in basic engineering, a minimum of twenty-five units in environmental engineering in one of three areas: air quality, water quality, or natural resource utilization, five subjects with at least forty-two units in environmental policy, up to twenty-nine units of electives and a thesis worth twenty-four units.

CURRENT FACULTY, STUDENTS, GRADUATES

Because of the interdepartmental structure of the program and the vast number of environmentally related subjects offered in the School of Engineering, it is impossible to tell exactly how many faculty members are involved in the program. Faculty members of the School are responsible for research as well as teaching in their primary fields. Several sources provide research funding for the program, including the National Science Foundation, the National Aeronautics and Space Administration, the National Weather Service, the U. S. Geological Survey and the Rockefeller Foundation.

The program has a current enrollment of three full-time students. Most have backgrounds in civil or nuclear engineering physics. No specific recruiting is done by the program. Many students have come from master's programs in one of the engineering departments and become interested in environmental topics. Almost all students receive some form of finanacial assistance, primarily research assistantships. A few training grants and fellowships are also available.

An average of two to three students complete the program each year, and this number is expected to remain stable. Approximately fifty percent of the graduates work in the private sector, usually for consulting firms. The remainder find employment with government agencies or research work. Graduate placement is usually through students or faculty contacts with employers.

PROGRAM PROJECTIONS

No real expansion in the program or faculty is anticipated in the near future although program officials indicated that there is some need seen for an undergraduate program.

COURSE DESCRIPTION (SELECTED)

1.731 Water Resources Systems I - Introduction to the fundamentals of water resources systems analysis, involving the determination of the optimal dimensions, target out-puts, and operating policies of water resource projects. (3 s.h.)

1.77 Water Quality Control - Analysis of environmental engineering problems in water quality and pollution control technology. Emphasis on predicting the distribution and fate of effluents discharged into lakes, reservoirs, rivers, estuaries, and oceans. (3 s.h.)

1.78 Water Quality Management - Systematic approach to the management of water quality. Identification of major issues and problem areas. Type, sources, and stochastic nature of waste materials and their effect on water bodies. (3 s.h.)

1.811 Environmental Law: Pollution - Review and analysis of common law, legislation, and regulation for pollution control. Focus on programs, analytical and decision processes for controlling water, air, and noise pollution, and the emission of toxic materials. (3 s.h.)

2.284 Water Purification - An introduction to water resource, water quality parameters and pollutants. Outline of various water purification processes and economic considerations for water supply and wastewater treatment. (3 s.h.)

10.17 Air Pollution Fundamentals - Introduction to the causes, effects, and control of air pollution with emphasis on combustion generated pollution and industrial process sources; origin and fate of air pollutants; air pollution meteorology; combustion processes and the formation of gaseous and particulate pollutants; air pollution control principles; measurement methods for gaseous air pollutants and for particulates. (2 s.h.)

19.03 Meteorologic Aspects of Air Pollution - Primary emphasis on the physical processes involved with motion and dilution of material released into the atmosphere. (3 s.h.)

22.37 Environmental Impact Power Production - An assessment of the various environmental impacts of producing thermal and electric power with currently available technology. (3 s.h.)

INSTITUTION: MICHIGAN STATE UNIVERSITY

PROGRAM: Environmental Engineering

DEPARTMENT: Civil and Sanitary Engineering

DEGREE: B.S. in Civil Engineering (emphasis in Environmental Engineering)
M.S. in Sanitary Engineering
Ph.D. in Sanitary Engineering

CONTACT: Dr. Mackenzie L. Davis
Department of Civil and Sanitary Engineering
College of Engineering
Michigan State University
East Lansing, Michigan 48824
(517) 353-6847

PROGRAM DESCRIPTION:

PROGRAM STRUCTURE

Undergraduate majors in Civil and Sanitary Engineering at Michigan State University can specialize in environmental engineering, while graduate programs in Sanitary Engineering emphasize water supply, process design of water treatment plants, biological aspects of wastewater treatment, air pollution, and problems of eutrophication. The graduate program generally has a strong emphasis in hydraulics and environmental fluid mechanics. The course offerings at all levels reflect an expansion of the essentially "water-oriented" civil engineering curriculum to encompass air, solid waste, and radiological health areas. At the same time, the Department has responded affirmatively to the recommendations of the Third National Environmental Engineering Conference by providing more courses at the undergraduate level.

Facilities include standard analytical laboratories for teaching and research, biology and chemistry laboratories devoted primarily to research, and a pilot plant laboratory which is connected to a raw sewage line and wastewater supply enabling students and staff to conduct treatability studies on water and wastewater. The Department co-sponsors regularly with the Michigan Department of Public Health and the American Waterworks Association seminars on groundwater chemistry and groundwater hydrology. It periodically offers a workshop on solid waste.

PROGRAM REQUIREMENTS

Undergraduate Civil Engineering majors must complete 180 quarter hours in humanities, social sciences, mathematics, basic sciences, and civil engineering (basics, design, concepts, and analysis). Entrance to the M.S. degree program demands completion of courses, or equivalents, in computer programming, chemistry, microbiology, environmental engineering, civil engineering, hydraulics sytems, and water and wastewater analysis and treatment. Also, applicants must have a bachelor's degree in an accredited engineering or related program and an undergraduate grade point average of 2.8. For the M.S. degree, students must complete 45 credits beyond the baccalaureate degree. Each candidate is required to take 12 hours in one or more areas which are not his/her principle area of study (i.e., sanitary engineering). Areas include chemical engineering, chemistry, environmental law, hydraulics, management, microbiology and public health, crop and soil science, and water resources.

The communication skills of the graduates of this program are important elements in their training. Though additional coursework may be substituted for the master's thesis, all students must prepare a scholarly paper, participate in technical seminars as a speaker and critic, and participate and report on 24 hours of field observation. "The objective of these requirements is to develop three skills which are not attainable in the normal classroom situation . . . (1) independent research and technical writing, (2) oral presentation of technical material, and (3) the power of critical observation and reporting. The field observation entails a minimum of eight hours in both a municipal water treatment plant and wastewater treatment plant. The remaining eight hours may be spent at any one or more of the following: industrial waste treatment plant; government office, laboratory, or field study; public hearing on environmental issues; consulting firm office; or municipal, county, or state legislative government meeting, including a court of law where an environmentally related suit is being argued.

A student may be admitted to a doctoral program if he/she has successful completed a master's degree or the equivalent. In general, the program is structured to provide a comprehensive knowledge of environmental engineering and related subjects and involves one year of coursework and one year in preparation of a dissertation based on original research.

CURRENT FACULTY, STUDENTS, GRADUATES

Three full-time faculty share responsibilities for the Environmental Engineering program. At the present time, there are approximately 60 undergraduates (juniors and seniors) in the Civil and Sanitary Engineering Department specializing in Environmental Engineering, 11 M.S. candidates, and 2 doctoral students. Averages for the past three years indicate that 10 M.S. and 2 Ph.D. students are enrolled annually in the Sanitary Engineering graduate program.

Baccalaureate students in the upper 10% of their class usually continue on for graduate studies at Michigan State and elsewhere. Approximately 80% of those students completing any given degree program take consultin jobs, 2% take industry jobs, and 18% enter government work. The market for women engineers in industry is particularly good. A limited number of teaching and research assistantships are open at the graduate level; other students support themselves through loans and part-time work or in the case of foreign students, with aid from their home governments. Undergraduates, if they choose, are placed in cooperative work programs related to their training (degree takes five years).

PROGRAM PROJECTIONS

The objective of the Michigan State program in Environmental Engineering is to produce "problem-solving" professionals. Training in Sanitary Engineering at M.S.U., and nationally, is broadening its focus to include air, solid waste, and radiological health areas in its curriculum. Enrollment appears stable for the next five years with projected increases over the next decade. Though the program is essentially without frills, faculty believe it offers a good, solid training to the students it serves.

COURSE DESCRIPTION*

Civil Engineering:

280 Introduction to Environmental Engineering - Hydrology; ground water and surface water supply systems; wastewater treatment, methods of pollution control for solid waste, air, and noise. (4 q.h.)

321 Introductory Fluid Mechanics - Fluid properties; hydrostatics; control volume approach to conservation of mass, momentum and energy; dimensional analysis and dynamic similitude; fluid resistance; pipe and open channel flows; boundary layer concepts. (5 q.h.)

421 Hydrology - Engineering hydrology; frequency and precipitation analysis; streamflow analysis and the unit hydrograph; flood precipitation; rainfall-runoff correlations; urban hydrology. (4 q.h.)

422 Hydraulic Systems - Steady flow in pipe networks; open channel flow; turbomachinery; groundwater hydraulics; introduction to unsteady flows. Applications to water supply systems; aquifer analysis; surges and water hammer. (4 q.h.)

481 Water and Wastewater Analysis - Quantitative analysis; bacteriologic and chemical characteristics of water and wastewater; principles of softening, iron removal, coagulation and chlorination; laboratory examination of water and wastewater including turbidity, solids, coliforms, chlorine, etc. (4 q.h.)

483 Water and Wastewater Treatment - Water treatment theory and design including sedimentation, coagulation, softening, iron removal and chlorination; wastewater treatment theory and design including grit chambers, activated sludge, trickling filter, and anaerobic digesters. (4 q.h.)

485 Environmental Health Engineering - Epidemiology of communicable disease transmitted by air, water, food and arthropods. Engineering measures to control disease spread. Incidence and prevalence rates, well design, cross-connections, disinfection, sanitary inspection. Case studies. (3 q.h.)

800 Operations Research Techniques for Civil Engineers - Elements of deterministic methods of operations research with emphasis on computational techniques and applications to civil engineering problems such as structural design, water supply, transportation, and construction management. (3 q.h.)

809 Finite Element Method - Theory and application of the finite element method to the solution of continuum type problems in heat transfer, fluid mechanics, and stress analysis. (4 q.h.)

827 Environmental Fluid Mechanics - Review of turbulent flow and transport processes in water quality control. Analysis and solution of ecological problems related to diffusion and disposal in rivers, estuaries, lakes, and the ocean environment. (4 q.h.)

828 Open Channel Flow - Fundamentals of free surface flow; steady uniform and nonuniform concepts; energy and momentum principles; subcritical and supercritical regimes; gradually and rapidly varied flow; design applications. (3 q.h.)

Sanitary Engineering:

802 Physical Chemical Processes of Environmental Engineering - Analysis of physical and chemical principles which form the basis of air and water pollution control and solid waste disposal; process dynamics, sedimentation, coagulation, filtration, adsorption, absorption, oxidation. (4 q.h.)

804 Biological Processes of Environmental Engineering - Aerobic and anaerobic degradation of liquid and solid wastes. Biochemical reactions; activated sludge and trickling filter kinetics; sludge digestion, and composting. (5 q.h.)

812 Water Treatment Plant Design - Theory and design of water treatment processes. Coagulation and flocculation; softening; sedimentation; filtration; disinfection. (4 q.h.)

814 Wastewater Treatment Plant Design - Theory and design of wastewater treatment processes. Racks, screens, sedimentation basins, tricking filters, aeration tanks, digesters. (4 q.h.)

816 Treatment of Industrial Wastes - Theory of industrial waste management. Application of physio-chemical and biological treatment to selected industries. Examples include: apparel; food processing; materials processing and chemical industry. (3 q.h.)

822 Air Resource Management - Characteristics of air contaminants and noise; sources and source inventory; microclimitology and pollutant transport; pollutant effects, introduction to sampling and control. (4 q.h.)

922 Air Pollution Control - Application of physical and chemical principles to control of gaseous and particulate air pollutants.

922 (Cont'd) - Cyclones, bag houses, electrostatic precipitators, adsorption, absorption, combustion. (4 q.h.)

924 Air Sampling and Analysis - Theory and design of air sampling programs. Quantitative analysis of ambient air samples and stack samples. Analysis for sulfur oxides, nitrogen oxides and particulates. (4 q.h.)

Chemical Engineering:

806 Thermodynamics and Kinetics in Chemical Engineering - Mass and energy balances in batch continuous and open systems. Process thermodynamics. Cryogenics. Properties of substances and mixtures. Phase equilibria. Chemical reaction equilibrium. Chemical reactor kinetics. Process design orientation. (4 q.h.)

807 Transfer and Separation Processes - Momentum, energy, and mass transfer. Laminar and turbulent flow. Fluid friction. Dimensional analysis. Heat through stationary and flowing materials. Interchangers. Condensation. Boiling. Binary and multicomponent distillation, absorption extraction. (4 q.h.)

Crop and Soil Sciences:

442 Soil Microbiology - Major groups of microorganisms of importance in soils are studied with emphasis on ecological, biochemical, and physical aspects. (3 q.h.)

840 Soil Physics - Physical properties of soil (texture, structure, consistency, aeration, water, temperature, etc.), their quantitative measurement, and relation to plant growth, and agronomic and engineering practices (5 q.h.)

850 Soil Chemistry - Chemistry of mineral weathering and soil formation, ion activities, ionic exchange and equilibrium reactions, soil pH, specific elements and their chemical analysis, and availability of nutrients to plants. (5 q.h.)

Fisheries and Wildlife:

875 Chemical Limnology - Application of analytical chemistry concepts and technologies to fundamental chemical mechanisms in natural and polluted water systems. Special consideration given to selected heterogeneous equilibria. (4 q.h.)

Resource Development:

420 Water Resource Development - Significance of water resources in modern society. Introduction to the needs of industry, agriculture, and recreation. Concepts of development, use and conservation are critically evaluated in terms of future needs. (4 q.h.)

832 Natural Resource Law - Legal principles of natural resources administration. Focus on natural resource jurisdiction. Discussion of state and federal cases, statutes, and treaties. Constitutional and common law. Limitations on governmental power. (3 q.h.)

835 Water Resources Law - Legal principles affecting private rights in state and federal regulation on surface and ground waters. Emphasis on water quality controls. (3 q.h.)

836 Environmental Law I - Public and private legal controls and restrictions on resource use, including common law, nuisance and trespass, citizen suits, class actions, appeals from agencies, Administrative Procedure Act, National Environmental Policy Act. (3 q.h.)

837 Environmental Law II - Analysis of federal government laws (NEPA, WQIA, Clean Air Act). Form and content of Environmental Impact Statements and problem of agency discretion and judicial review. (3 q.h.)

*500-level courses and above are for graduate students.

INSTITUTION: MIDDLE TENNESSEE STATE UNIVERSITY

PROGRAM: Environmental Science and Technology

DEPARTMENT: Industrial Studies

DEGREE: Bachelor of Science (B.S.)

CONTACT: Dr. William Mathis, Coordinator
Environmental Science and Technology
Department of Industrial Studies
Middle Tennessee State University
Murfreesboro, Tennessee 37132
(615) 898-2778

PROGRAM DESCRIPTION:

PROGRAM STRUCTURE

A relatively new program, Environmental Science and Technology was begun in 1973 in response to the increasingly complex nature of environmental care. The program is designed to provide the student who is interested in employment in environmental pollution control a background of educational experiences related to environmental quality.

The Department of Industrial Studies administers the program, and it is conducted jointly by the Departments of Agriculture, Biology, Chemistry and Physics, and Industrial Studies. Courses for this interdisciplinary curriculum are in sciences and mathematics, agriculture and technology, and the liberal arts.

Graduates are qualified to pursue employment in the various levels of government and environmentally related agencies, and in the manufacturing, construction, and agricultural industries in areas such as air and water quality control, wastewater management and treatment, solid waste management and recycling, and in noise and radiation control. Graduates are also fit industrial hygienists, industrial supply supervisors, and forestry ecologists.

Recruitment activities take two forms; the first being the dispensing of literature to high schools, and the second being by way of Environmental Insights, which is a series of seminars offered each spring on a central theme. People from the university and the community at large are invited to attend these seminars. Enrollment has increased by 20 percent each year since its inception.

PROGRAM REQUIREMENTS

For admission, in-state applicants must have graduated from a state approved or regionally accredited high school and must have either a 2.0 average for three successive years or a composite score of 16 on the ACT Test. Out-of-state applicants must have either approved or accredited high school diplomas or must have obtained a forty-five or above composite score on the G.E.D. Test. In addition, they must have a composite score of 16 on the ACT Test.

General requirements for a major in Environmental Science and Technology are: a minimum of forty-four semester hours of biology, chemistry, and physics; a minimum of twelve semester hours of mathematics; and a minimum of eighteen semester hours of agricultural and industrial studies courses related to environmental problems. A minor in Environmental Sciences and Technology may be completed with eighteen semester hours of courses which have been approved by the program coordinator. During their junior and senior years, majors must attend one designated seminar in each of the four cooperating departments.

CURRENT FACULTY, STUDENTS, GRADUATES

One person is assigned to coordinate the program on a full-time basis. It is estimated that an additional nine persons from cooperating departments have teaching responsibilities to Environmental Science and Technology part-time. There are thirty-one students enrolled in the program, with an average of twelve graduates per year.

While no formal follow-up study has been conducted, it is estimated that 100 percent of the graduates are able to locate environmentally related employment. Commonly, students use the school's placement office and with good results. Sources feel that the most usual employer is the U.S. government. Approximately 10 percent of the graduates continue their schooling in graduate level programs.

PROGRAM PROJECTIONS

Responding to the need for alternate energy sources and for increased sophistication relative to current energy technologies, one survey course in energy will soon be offered. Additionally, the topic of energy as an option for concentration is being planned.

In order to create a sense of cohesiveness about this program, a freshman orientation course will be added to the list of program requirements shortly.

COURSE DESCRIPTION

Required Courses *

Geog 431 Conservation of Environmental Resources - Current problems related to use of environmental resources. Topics include: air, water, and other resources. (3 s.h.)

Agri 337 Analysis of Soils - Chemical and physical analysis of soils in the laboratory. Cation exchange capacity, soil acidity and lime requirements, organic matter, available water holding capacity, soil texture, quick tests for available phosphorus and potassium. (3 s.h.)

Agri 363 Forestry - Culture, conservations, management, and utilization of forest stands; forest product industries; forest history, agencies, and policies; multiple-use and forest resources. (3 s.h.)

Agri 434 Soils and Environment* - Environmental factors affecting origin, taxonomy, and utilization of soils. Principles of soil management, soil judging, physical geology. (3 s.h.)

Agri 370 Environmental Agriculture* - Technical agriculture as it relates to the environment. Role of agriculture in an environmentally conscious world. (3 s.h.)

Agri 435 Soil Surveys in Urban Planning - Soil properties, related pollution problems, land suitability, specific criteria, aesthetic value, and economic importance in evaluating the use of land and rural-fringe areas. (3 s.h.)

Chem 470 Introduction to Environmental Chemistry* - Quality of the environment relative to chemical changes through contamination or modification of air, water, and soil as affected by agricultural, industrial, and social activities. (3 s.h.)

Chem 471 Detection of Chemical Pollutants* - Theory and practice of methods of analytical chemistry which are used in pollution measurement. (3 s.h.)

Biol 211 Bacteriology* - Concepts and techniques pertaining to isolation, cultivation, morphology, reaction, physiology, and nutrition of bacteria. (3 s.h.)

Biol 307 Biology Seminar on Environmental Problems - Environmental problems: causes; effects, and solutions. (3 s.h.)

Biol 424 Ecology* - Basic concepts of the ecosystem and community, aquatic and terrestrial habitats and population ecology. (3 s.h.)

Biol 425 Limnology* - Biological, chemical, and physical aspects of freshwater lakes and streams. Interrelationships of organisms and the aquatic biotope. (4 s.h.)

IS 477 Water and Wastewater Technology* - Water pollution control technology. Legislative regulations and quality standards, pollution types and sources, detection and analysis instruments, and treatment principles and practices for liquid wastes. (4 s.h.)

IS 478 Air, Solids, and Noise Pollution Technology* - Introduction to air, solid waste, noise, and radioactive pollution technology. Legislative regulations and quality standards. Sources, detection, and analysis instrumentation and practices. Treatment and abatement principles, equipment and practices. (4 s.h.)

IS 476 A,B,C, and D Seminar in Environmental Science and Technology* - Interdisciplinary seminars conducted jointly by the Departments of Agriculture, Biology, Chemistry, and Industrial Studies. Guest lecturers, agency and resource personnel, readings, reflective thought, films, and discussions on environmental problems and issues, new and proposed legislation, and the role of environmental science and technology in pollution control. (1 s.h. each)

INSTITUTION: MIDDLESEX COUNTY COLLEGE

PROGRAM: Environmental Health Science Technology

DEPARTMENT: Science Division

DEGREE: Associate of Applied Science (A.A.S.)

CONTACT: Diane Trainer, Chemistry Department
Middlesex County College
Edison, New Jersey 08817
(201) 548-6000 extension 241

PROGRAM DESCRIPTION:

PROGRAM STRUCTURE

Middlesex County College initiated its Environmental Health Science Technology Program in 1971 to train technicians as: laboratory technicians to perform air, water, and wastewater analyses; water and wastewater treatment plant operators, air pollution inspectors; stack samplers; public health enforcement officers (sanitorians and food and drug inspectors); and industrial hygiene technicians. Emphasis is placed to produce graduates with both flexibility and adaptability so they are able to work in more than one pollution control and abatement area.

This two year program stresses environmental laboratory training, and courses are integrated from biology, chemistry, physics, microbiology and other areas. The program offers advantages to students of low tuition, modern equipment and facilities, personalized laboratory supervision, and faculty with teaching and industrial experience.

PROGRAM REQUIREMENTS

In order to enter the Environmental Health Science Program, a prospective student must be a high school graduate, have one year of laboratory science and one year of Algebra. Structured into the two year, four semester curriculum are sixty-four credits of courses which include water and wastewater treatment, environmental microbiology, air pollution control, sanitary chemistry, industrial hygiene, and community sanitation. Six credits of humanities and social science electives must be taken within the present structure.

In the second semester of the second year, the students are employed for one day each week. However, they are not salaried and their primary function is one of observation. One college credit is received for their participation in this internship program. A log is kept by the student of the activities in which they participated and at the end of the period, the students immediate job supervisor writes an evaluation of the student's performance. This internship program has often enabled students to use the evaluations as letters of recommendation when later searching for employment or being offered jobs by their internship employer.

Financial aid from the State of New Jersey is available to students and a few receive work-study funding. Students also have access to other federal programs such as the Educational Opportunity Fund, ROTC, and the Basic Educational Opportunity Grant Programs.

CURRENT FACULTY, STUDENTS, GRADUATES

Four faculty members currently teach concepts of environmental science to students enrolled in the Environmental Health Science Program and all are full-time. The Program currently has an enrollment of 19 students, full-time, and four part-time. Four of the full-time students are female. Since the program was initiated in 1971, there has been a consistent graduating class of fifteen students.

About forty percent of the annual graduates transfer into other college or university environmental programs. Middlesex Environmental Health Science graduates often attend Bachelor degree programs offered by Rutgers, Stockton State College, Ramapo State College, New Jersey Institute of Technology, Michigan Tech, and San Jose State College. The College maintains a placement service and a job counseling service to assist students in their employment search. Program officials estimate that of ten total graduates, six found employment and four are college transfers. Of seven 1976 graduates surveyed by the College in 1976, six found employment in their field and one in a related field. Only one of the seven found employment with a governmental agency.

PROGRAM PROJECTIONS

Although College officials project that environmental programs are continuing to increase in number and size, the emphasis is mainly in specific areas, e.g. industrial hygiene, energy, and water. There are no current plans being made by College officials to expand the Environmental Health Science Technology Program because no real need exists at present. However, due to an increased enrollment, one additional faculty member will be recruited in 1978 to teach environmental science and chemistry courses.

COURSE DESCRIPTION

ENV 201 Advanced Wastewater I - Covers such topics as wastewater characteristics, flow measuring devices, physical treatment systems, and sludge digestion and disposal. (3 s.h.)

ENV 202 Advanced Wastewater II - Covers an approach to total treatment of wastewater. Prepares a student for the NJ State Wastewater Operators License. (3 s.h.)

ENV 203 Advanced Water Operations I - Sources of water and their characteristics, water cycle balance, reservoirs in NJ, surface and ground water supplies, methods of analysis, disinfection, tastes, and odors. (3 s.h.)

ENV 204 Advanced Water Operations II - Water treatment operations including pretreatment and filtration, distribution systems, records, budgeting, and supervision. ENV 203 and 204 must be taken to prepare a student for the NJ State Water Operators License. (3 s.h.)

ENV 205 Atmospheric Pollution - Community air pollution, stressing problems and the technology used for their detection and control. (3 s.h.)

ENV 207 Concepts of Environmental Science - A one-semester course for the career-oriented student that explores the possible causes and cures of all types of pollution in our society. (3 s.h.)

ENV 208 Community Sanitation - A survey of current community and environmental health problems with emphasis on communicable diseases, waste disposal, water and air pollution control, food sanitation and radiological health, and other topics. (3 s.h.)

ENV 211 Environmental Science I - Emphasis is on the water and air environment. Includes laboratory and field trips. (4 s.h.)

ENV 212 Environmental Science II - Focuses on solid wastes, noise, energy, radiation, and other miscellaneous environmental areas of concern. (4 s.h.)

ENV 222 Water and Wastewater Analysis - A systematic study of laboratory procedures as applied to water analysis and purification. (3 s.h.)

ENV 250 Environmental Internship - One day per week exposure to an environmental career. (1 s.h.)

ENV 220 Industrial Hygiene - This course examines the sampling and analytical techniques required to evaluate the safety and health hazards associated with the industrial environment. (3 s.h.)

INSTITUTION: MUSKINGUM AREA TECHNICAL COLLEGE (MATC)

PROGRAM: Environmental Quality Control Technology (air and water options)
DEPARTMENT: Division of Engineering and Science
DEGREE: Associate of Applied Science

CONTACT: Mr. Charles M. Woolf, Division Chairman
Division of Engineering and Science
Muskingum Area Technical College
1555 Newark Road
Zanesville, Ohio 43701
(614) 454-2501

PROGRAM DESCRIPTION:

PROGRAM STRUCTURE

The Environmental Quality Control Technology program offered at Muskingum Area Technical College is designed to train paraprofessionals to meet manpower needs necessitated by stricter legislation and enforcement of environmental quality standards. Graduates receive an Associate of Applied Science degree preparing them to work with professional biologists, chemists, engineers, and environmentalists in conducting air and water quality studies. Their work includes the collection and analysis of air and water samples for routine monitoring, special studies, and for insuring compliance with environmental quality laws.

During the second-year of this two-year program, students may choose two technical electives that provide them with a more intensive training in either air or water quality. However, students are now encouraged to take the technical electives under both options; and all students currently enrolled do so. All other coursework for the two options is identical. The college maintains analytic and mobile laboratories for each option area all equipped with a broad spectrum of instrumentation. The air laboratories permit meteorological and air sampling tests while the water quality labs allow water testing. Students learn to maintain and operate all of the equipment in these laboratories (10 to 15 percent of the equipment was donated by the Environmental Protection Agency). The meteorological recording station is the only one in a five-county area. Nearby industries cooperate in on-site visits by students to their facilities.

Environmental Quality Control Technology faculty have conducted workshops for the Ohio Environmental Protection Agency in the area of particulate analysis (air)and for high school students and and teachers on more general topics. State certification in microbiological particulate analysis is almost complete, and work toward certification in inorganic analysis will begin soon. As a service to public agencies, the program also sponsors a testing lab for the National Pollution Discharge Elimination System (NPDES) which gives students experience while in school for jobs upon graduation.

Curriculum oversight is provided by an advisory committee of local citizens in the environmental quality field. All students intern during the summer months in some form of employment related to their particular technological interests and receive college credits for this work. The environmental program presently has a special intern on-the-job arrangement with the City of Zanesville for outstanding students.

PROGRAM REQUIREMENTS

To obtain the Associate of Applied Science in either Air or Water Quality, the student must complete 110 quarter hours in basic sciences, mathematics, communication, social sciences, and, of course, environmental sciences. Admission to MATC requires a high school diploma or its equivalent.

CURRENT FACULTY, STUDENTS, GRADUATES

Two faculty members serve the 23 first-year and 13 second-year students currently enrolled in the program. The statistics on program graduates (six in 1976, nine in 1977) indicate an increasing number of students who are completing this course of study. Financial assistance consists of standard programs such as Basic Educational Opportunity Grants, Ohio Instructional Grants, College Work-Study, National Direct Student Loan, Supplemental Educational Opportunity Grants, and Ohio Student Loans.

On the average, over two-thirds of the Environmental Quality Control graduates gain employment in their technological field. There are no reported problems with placement though the faculty note that available positions in municipalities, consulting firms, industry, and the Environmental Protection Agency are limited to those requiring two-year graduates. The college cannot fill all the water and wastewater jobs listed at MATC. Employment opportunities come through the college placement office (each technology has its own placement officer), the student's internship experience, and the program's advisory committee. Jobs are available to graduates of this program in public health departments, pollution control equipment manufacturing, municipal water and wastewater treatment facilities, federal and state fish and wildlife departments, U.S. Corps of Engineers, private consulting firms, research laboratories, private industries, federal and state Environmental Protection Agency offices, and local environmental control boards.

PROGRAM PROJECTIONS

The faculty of the Environmental Quality Control department predict a stable future for their program. Depending on decisions by the Environmental Protection Agency and changing career opportunities, the program may shift toward more water-related courses (water distribution, wastewater, etc.). An additional staff member in biology will have to be hired in the next five years to meet enrollment demands.

A major concern of the staff at MATC is the lack of employer awareness of the capabilities of the two-year technician who has both practical skills and theoretical knowledge. Staff personnel contend that public support, training monies for students and workshops, and increased enrollments are essential in order to maintain the current environmental programs in the State of Ohio.

COURSE DESCRIPTION *

BIOL 141 Field Zoology and Ecology - A study of the animals common to this area, stressing identification and the environmental aspects which affect their distribution. The basic principles of ecology are covered with emphasis on the interrelationships between an animal and his physical and biological surroundings. (3 q.h.)

ENV 111 Industrial Processing and Pollution Control I - Prime emphasis will be the study of major manufacturing and industrial processes and products with orientation towards the origins of the pollutants and the engineering problems involved in their control. Each industry's air, water, and solid waste problems will be studied from the industrial engineer's viewpoint with emphasis on a total solution. (3 q.h.)

ENV 151 Introduction to Environmental Quality Problems - An introduction to environmental pollution, its effects on man, other animals, and plants. It includes discussion of the major pollution sources, and health and economic problems created by pollutants. (3 q.h.)

ENV 135 Earth Science - A study of the physical principles guiding the earth's development, including basic geology, weathering and land forms; the method of locating points on the earth and principles of mapping; principles of meteorology; interactions of abiotic and biotic components of the environment. (3 q.h.)

ENV 112 Industrial Processing and Pollution Control II - This is a continuation of ENV 111 looking at major industries and their unique problems associated with pollution control. (3 q.h.)

CHEM 111 Chemistry--Basic and Organic - designed to introduce the students to the basic principles of chemistry, atomic theory, CHEM 111 (Cont'd) - chemical bonding, reactions, and other aspects of preparatory chemistry. This course specifically meets the needs of field analysis and laboratory in environmental quality control. It will include studies of organic compounds as pollutant compounds. Laboratories will include testing techniques specific to environmental quality control. (4 q.h.)

ENV 121 Air Sampling and Analysis - A study of the standard techniques of ambient air sampling. This course shall include an understanding of the principles of operation and maintenance of air sampling equipment; an understanding of the analytical (quantitative and qualitative) techniques used to identify and measure air pollutants; experience in site selection and in collection of various types of air samples; practical experience in laboratory analysis of air samples by the standard methods of wet chemistry, colorimetric method, and instrumental analysis; and the interpretation of data collected and analyzed by the students. (4 q.h.)

ENV 171 Water Sampling and Analysis - The course is designed to give practice in water sampling techniques and chemical analysis (wet chemistry, instrumental analysis, and by portable test kits) of the water quality of streams and lakes. It also includes studies of new methods, techniques, instruments in field sampling and laboratory analysis, data interpretation, and reporting results. (4 q.h.)

ENV 251 Environmental Quality Laws and Enforcement - An analysis of existing environmental quality control laws, methods of establishment, and the enforcement practices of the different governmental agencies. (3 q.h.)

NS 200 Internship - Supervised work experience required for environmental sciences students. Includes student applying for job in related area, on-the-job supervision, scheduled visits by coordinators, and periodic evaluations. (7 q.h.)

NS 299 Seminar - Course taken in conjunction with Internship. Includes discussion of students' intern experiences, principles of employment practices, and improvement of employee traits. (3 q.h.)

ENV 271 Environmental Instrumentation - An introduction to the types of measuring means and their function, their operation, practical construction, and uses. Instrumentation terminology and measuring devices for temperature, flow rates, level control, pressure, other control devices, monitoring, and recording instruments are studied. (4 q.h.)

ENV 291 Water Treatment Techniques - The course is designed to provide the formal training to allow the student to attempt the State of Ohio Class One Operator Water Exam. The course will emphasize sources, water softening, water hygiene and

ENV 291 (Cont'd) - public health aspects, distribution systems, types of equipment and treatments, and budgetry. (4 q.h.)

ENV 235 Environmental Science Computer Applications - Introduction to computing sciences for the analysis and interpretation of environmental data and computer print-out. Simple statistical treatment of data is combined with the utilization of simple calculators, programmable calculators, the PDP-8 terminal computer, and the IBM 360-30 computer. Simple programming is combined with other computer operations such as keypunching and sorting, and the use of pre-programmed packages. (3 q.h.)

ENV 281 Environmental Health - An investigation into the activities of the state and local health departments including their role in setting environmental standards and methods of inspection for water, wastewater treatment facilities, air quality monitoring, insect vector and rodent control, pesticide use, radiation safety, milk and food service, and communicable disease control. (4 q.h.)

ENV 211 Emission Control Techniques - A study of industrial and vehicular emissions, presenting the fundamental principles of gravitational settling, inertia, filtration, absorption, and combustion applicable to control of various pollutants at their sources with odor and noise control. (3 q.h.)

BIOL 151 Field Botany and Ecology - A study of the structure and life processes of plants, the classification and identification of plants, and the basic principles of plant ecology stressing the environmental affects on the morphology, physiology, and distribution of plants. (3 q.h.)

ENV 215 Wastewater Treatment Techniques - The course is designed to provide the training to permit the student to apply for the State of Ohio Class One Operator Wastewater Exam. The course will emphasize types of treatment and equipment, wastewater hygiene and public health aspects, sewer systems, and budgetry considerations. (4 q.h.)

ENV 225 Stack Gas Sampling and Analysis - The course stresses the basic techniques in source sampling at the stack and the specific analytical techniques required. It also includes the areas of monitor design, isokinetic techniques, and continued vs. periodic sampling techniques. Experiences are gained through practical lab and field work. (3 q.h.)

Technical Electives - Air Option:

ENV 285 Blueprint Interpretation - An introduction to the theory of projection and dimensioning as related to working drawings and blueprints. Development of ability to interpret shape, ENV 285 (Cont'd) - size, position, and functional relationships of structures and mechanisms from blueprints. (3 q.h.)

EE 251 Introduction to Electricity/Electronics - A study of the fundamentals of the science, the how and why circuits behave as they do and their relationship to common devices. Provides an introduction to electricity/electronics. (3 q.h.)

Technical Electives - Water Option:

ENV 265 Microbiological Techniques - The basic techniques in culturing and identifying microorganisms, with emphasis on the bacteriological techniques used in water quality analysis and the environmental health field. (3 q.h.)

ENV 275 Aquatic Organisms - Identification and classification of common aquatic life from microorganisms to vascular plants and vertebrates; ecological relationships, environmental needs and responses to change, and the use of diversity index and indicator species. (3 q.h.)

* courses are listed in the sequence taken by the student

INSTITUTION: NEW JERSEY INSTITUTE OF TECHNOLOGY

PROGRAM: Interdisciplinary Studies in Environmental Engineering
DEPARTMENT: Interdepartmental
DEGREE: Master of Science (M.S.)

CONTACT: Dr. Eugene Golub
Chairman, Dept. of Civil and Environmental Engineering
New Jersey Institute of Technology
323 High Street
Newark, New Jersey 07102
(201) 645-5321

PROGRAM DESCRIPTION:

PROGRAM STRUCTURE

Because of the need for interdisciplinary approaches to environmental problems, New Jersey Institute of Technology offers a program for students of various backgrounds and interests. The program began four years ago and is offered in addition to an environmental option in civil engineering.

Program administration is accomplished by the Environmental Engineering Committee, an inter-departmental faculty group. Five specializations are offered in the program: industrial waste, pollution control, water resources and water treatment, municipal waste treatment, air pollution control, and solid waste management. Students follow a curriculum approved by a faculty advisor and take courses offered by various departments, primarily civil and environmental engineering, chemical engineering, and mechanical engineering.

Support facilities include the laboratories of the various engineering departments.

PROGRAM REQUIREMENTS

Admission to the program requires an undergraduate degree in engineering, normally from an ECPD addredited Program. It is also recommended that the applicant take the aptitude test and advanced portions of the Graduate Record Examination.

For the M.S. degree, each student must complete eighteen credits of specialization, twelve credits of electives including six credits outside the department of specialization, and a thesis. Each student must also take the following courses: environmental chemistry and legal aspects in environmental engineering.

A student may select courses, with the assistance of the faculty advisor, to fulfill the specialization and elective requirements. The student normally selects courses recommended for one of the five specializations. He can, however, select courses in more than one specialization or from other departments, in line with his career objectives and prior preparation.

CURRENT FACULTY, STUDENTS, GRADUATES

There are currently a total of ten faculty members, all full-time, participating in the program. They divide their time equally between teaching and research. Research is normally performed in the department of the faculty member involved and funding is provided primarily through EPA research grants and the New Jersey Department of Environmental Protection.

A large majority of the students in the program, about 96 percent, come from New Jersey. Little direct recruiting is done for the program and most students become aware of it through other students or faculty. Current sources of student financial support include teaching assistantships, research assistantships, and fellowships.

Although no formal follow-up is done on program graduates, officials indicated that most find employment within the private sector. Jobs are usually found through individual contact by the student or faculty members or through the school's placement service.

PROGRAM PROJECTIONS

Program officials see a need for expansion of the curriculum and in number of students, but feel it is unlikely that this will occur in the near future because of financial reasons.

COURSE DESCRIPTION (SELECTED)

ChE 685 Unit Operations for Industrial Waste Treatment - A course which introduces the student to basic concepts of unit operations which are applicable to the treatment of industrial effluent streams and for municipal waste water advanced treatment. (3 s.h.)

ChE 686 Industrial Waste and Control - The industrial processes and the resulting waste problems associated with key industries are examined. (3 s.h.)

EnE 560 Environmental Chemistry - Basic physical and chemical principles applicable to environmental and sanitary engineering are presented and amplified in the laboratory. (3 s.h.)

EnE 660 Introduction to Solid Waste Porblems - An introductory course in solid waste disposal which covers industrial and urban sources of solid waste and the conventional methods of disposal of these wastes. (3 s.h.)

EnE 663 Pollution: Chemistry and Ecology - This course considers the nature and effects of pollution as it relates to air, water, and soil, and the inhabitants of these areas. Pollution prevention and current pollution research is studied. (3 s.h.)

EnE 668 Air Pollution Control - The nature of the air pollution problem, its effect on the public at large, and the present legal and engineering controls used to combat the problem are considered. (3 s.h.)

EnE 671 Environmental Impact Analysis - Overview of environmental problems, federal and state standards, methodology for developing impact statements, case studies based on recent experience, basis for assessment and decision-making. (3 s.h.)

EM 631 Legal Aspects in Environmental Engineering - A study of the power of the federal, state, local governments and international law in pollution control of air, water and solid wastes. (3 s.h.)

ME 660 Noise Control - A study of engineering methods for reducing noise pollution including reduction of intensity at the source, limitation of transmission paths and absorption; applications to structures, machinery, ground transportation, and aircraft; and noise measurement. (3 s.h.)

ME 661 Thermal Pollution of Water and Air - Study of sources and processes causing thermal pollution and their effects on the environment; study of heat exchange mechanisms between water and air with emphasis on thermal pollution of rivers, streams, lakes and reservoirs; design of cooling ponds and towers; and use of instruments and techniques in thermal pollution control. (3 s.h.)

ME 662 Air Pollution Control and Design - An investigation of the techniques utilized for the solution of air pollution problems. (3 s.h.)

INSTITUTION: NORTH CAROLINA STATE UNIVERSITY

PROGRAM: Environmental Engineering

DEPARTMENT: Civil Engineering

DEGREE: Master of Science in Civil Engineering (M.S.)
Master of Civil Engineering (M.C.E.)
Doctor of Philosophy (Ph.D.)

CONTACT: Professor Charles Smallwood, Jr.
Professor of Civil Engineering
Department of Civil Engineering
North Carolina State University
Raleigh, North Carolina 27611
(919) 737-2331

PROGRAM DESCRIPTION:

PROGRAM STRUCTURE

The Department of Civil Engineering at North Carolina State University is one of the largest in the United States, with a current enrollment of over one thousand, including both undergraduate and graduate students. Environmental Engineering is a graduate program under the administration of the Civil Engineering Department, offering three degrees: the Master of Science in Civil Engineering (M.S.), the Master of Civil Engineering (M.C.E.), and the Doctor of Philosophy (Ph.D.). The M.C.E. program is accredited by the Engineers' Council for Professional Development. The undergraduate civil engineering program began in 1888; graduate programs began in 1954. Graduates of the masters programs are qualified for employment as sanitary/environmental engineers in governmental agencies, industries, and consulting engineering firms. Ph.D. graduates are also qualified for these positions, as well as for research and teaching positions in colleges and universities.

The Sanitary Engineering Laboratories contain over three thousand square feet of space. The library contains over 600,000 volumes of scientific and technological material. Computer facilities are available, as is a MW PULSTAR nuclear reactor. Being installed, under a grant from the U.S. Environmental Protection Agency, is a fifty pound per hour fluidized bed coal gasification unit.

Faculty and students in environmental engineering carry out a variety of research projects that are environmentally related. Current sponsored areas of research include the development of a hydrodynamic and water quality model for the Chowan River Estuary, measurement of rural non-point source pollution, the effect of ocean outfalls on coastal waters, and the use of pure oxygen in the treatment of industrial wastewaters. Ph.D. dissertations and master's theses cover an array of related topics. The availability of the fluidized bed coal gasification unit will provide opportunities for special projects and thesis research that otherwise might not be available. Typical projects may include material balances around the unit to determine the quantities of the waste streams, effects of liquid waste on stream life, and the assessment of the effects of different treatment schemes.

PROGRAM REQUIREMENTS

The M.C.E. degree is available only to students holding an ECPD-accredited bachelor's degree in Civil Engineering. This is a non-thesis, design-oriented degree which does require an independent study or project report. The M.S. degree can be obtained by students holding a bachelor's degree in any field of engineering, or by students having degrees in other disciplines who correct any deficiencies in mathematics, the basic sciences, and the engineering sciences. Students may select the M.S. with thesis or the M.S. without thesis option. In all cases, the master's degrees require a minimum of thirty semester hours of credit. The programs are individually tailored to meet the needs and desires of the graduate students. However, five courses are considered to be core, and are required of all students in Environmental Engineering.

Program administrators consider the doctorate degree to symbolize the ability of the recipient to undertake original research and scholarly work at the highest levels without supervision. The degree is not granted simply upon completion of a stated amount of course work, but rather upon demonstration by the student of a comprehensive knowledge and high attainment in scholarship in a specialized field of study. The student must demonstrate this ability by writing a dissertation that reports the results of an original investigation, and by passing a series of comprehensive examinations on the field of specialization and related areas of knowledge.

Every student must carry a minor area of concentration. Normally, a minor consists of one-third of a person's required hours at the master's and Ph.D. level. Students with majors in other disciplines such as wood and paper science, textile chemistry, and food science may also carry a minor in environmental engineering at the graduate level.

CURRENT FACULTY, STUDENTS, GRADUATES

Eight faculty members of the Department of Civil Engineering contribute to the Environmental Engineering program. Their efforts are estimated at 70 percent teaching and 30 percent research. Six of these faculty members work full-time with this program.

Twenty-two students are currently majoring in Environmental Engineering, and twenty are minoring in this field. One student majoring in in the field is sponsored under a training grant, five are supported under research assistantships, and the remainder are self-supporting. The number graduating with master's degrees in Environmental Engineering has decreased from eleven in 1974-1975 to eight in 1976-1977; this is attributed to the decline of training grants available. The annual number of those receiving the Ph.D. in Environmental Engineering has averaged two to three.

Follow-up data on graduates indicate that of twenty-nine graduates since 1974, eleven have gone to governmental agencies, eleven to consulting engineering firms, and two to private industry. Additionally, two have become instructors, two have returned to their home countries, and one has continued his/her schooling. All have remained within the field of environmental engineering. It is noteworthy that the food scientists, textile chemists, and pulp and paper engineers who minor in pollution control and abatement are often first to find employment because of their value in both production and control in manufacturing activities.

PROGRAM PROJECTIONS

Because of the lack of training grants, and a school-wide enrollment quota, administrators anticipate that the number of students in Environmental Engineering will remain stable or slightly decline. Plans are underway, however, to expand the curriculum with three new areas of concentration. The first area relates to the environmental impact of energy systems. Two traineeships are being requested from the U.S. Department of Energy; these students would take the Environmental Engineering core and carry a strong minor with energy-related courses. All would be required to complete a major project or thesis in this area. Also being considered is the development of a subprogram in urban hydrology and non-point sources. Students would also have the option of concentrating in this area within the Environmental Engineering program. Finally, the department may coordinate with the Department of Economics and Business in offering a stronger concentration in management and economics in environmental engineering. Graduates with this concentration would be qualified to manage county-level waste management agencies or to manage water or wastewater treatment plants.

ADDITIONAL INFORMATION

Program officials have emphasized that sanitary/environmental engineers, in their employment endeavors, are constantly concerned with energy recovery and/or conversion. For example, sludge dewatering is a major source of energy consumption and is facilitated by the anaerobic digestion process, which may recover energy from methane production. Another example is the backwash process in both water and waste treatment. The high rates of pumping require large amounts of energy, which may be minimized by careful scheduling. In addition, a large number of civil engineers are employed in the planning, design, construction and operation of hydroelectric, fossil, and nuclear power plants.

COURSE DESCRIPTION

Core Courses:

CE (BAE, MB) 570 Sanitary Microbiology - Fundamental aspects of microbiology and biochemistry are presented and related to problems of stream pollution, refuse disposal and biological treatment. Laboratory exercises present basic microbiological techniques and illustrate from a chemical viewpoint some of the basic microbial aspects of waste disposal. (3 s.h.)

CE 571 Theory of Water and Waste Treatment - Study of the basic physical and chemical processes underlying water and waste treatment, including mass transfer, equilibria, kinetics. (3 s.h.)

CE 572 Design of Water and Wastewater Facilities - Theory and design of water and wastewater treatment plants. (3 s.h.)

CE 573 Unit Operations and Processes in Waste Treatment - Unit operations and processes in water and wastes engineering, including sedimentation, thickening, chemical coagulation, vacuum filtration, carbon absorption, biological treatment, and special projects. (3 s.h.)

CE 672 Advanced Water and Waste Treatment: Principles and Design - Theory and design of physiochemical processes used to control phosphorus, nitrogen, trace metals, toxic organic substances in water. (4 s.h.)

Other Environmental Engineering Graduate Courses:

CE 506 Municipal Engineering Projects - Special problems relating to public works, public utilities, urban planning and city engineering. (3 s.h.)

CE 543 Hydraulics of Ground Water - Principles of ground water hydraulics; theory of flow through idealized porous media; the flow net solution; seepage and well problems. (3 s.h.)

CE (NE) 574 Environmental Consequences of Nuclear Power - An examination of the environmental consequences resulting from the siting, construction and operation of nuclear power plants as well as the environmental consequences of alternatives to nuclear power. Fuel sources; fuel reprocessing; sources and treatment of solid, liquid, gaseous wastes; the costs of minimizing wastes and the effects of rejected heat; beneficial uses of rejected heat; pertinent regulations are examined. (3 s.h.)

CE 575 Civil Engineering Systems - An examination of civil engineering systems and their design optimization. Systems include water resources engineering, structural engineering, transportation engineering, and construction. (3 s.h.)

CE 576 Atmospheric Pollution - A survey of the problem of atmospheric pollution. Pollutant sources; effects on man and other animals, vegetation, materials and visibility; meteorological factors, air sampling; control devices; air quality and emission standards; legal economic and administrative aspects. (3 s.h.)

CE 580 Flow in Open Channels - The theory and applications of flow in open channels, including dimensional analysis, momentum-energy principle, gradually varied flow, high-velocity flow, energy dissipators, spillways, waves, channel transitions and model studies. (3 s.h.)

CE (MAS) 581 Introduction to Oceanographic Engineering - A rigorous treatment of the engineering aspects of physical oceanography. The theory for the propagation of waves, methods of wave forecasting and the analysis of wave spectra. The applications of physical oceanography to the design of marine and coastal installations. (3 s.h.)

CE 598 Civil Engineering Projects - Special projects in some phase of civil engineering. (1-6 s.h.)

CE 644 Ground Water Engineering - Ground water problems as related to engineering works, ground water circulation and inventories, subsidence of the ground and its evaluation due to pumping, method of images applied to water circulation of wastes and salt water encroachment in coastal aquifers, transient flow systems in wells and earth dams and embankments. Leakage problems, practical ground water problems and their analysis by computers and electrical models. The legal aspects of ground water conservation and the implied technical and engineering phases. (3 s.h.)

CE 671 Advanced Water Management Systems - The application of systems analysis methods to the design, analysis and management of water and waste systems. (4 s.h.)

CE 673 Industrial Water Supply and Waste Disposal - Water requirements of industry and the disposal of industrial wastes. (3 s.h.)

CE 674 Stream Sanitation - Biological, chemical and hydrological factors that affect stream sanitation and stream use. (3 s.h.)